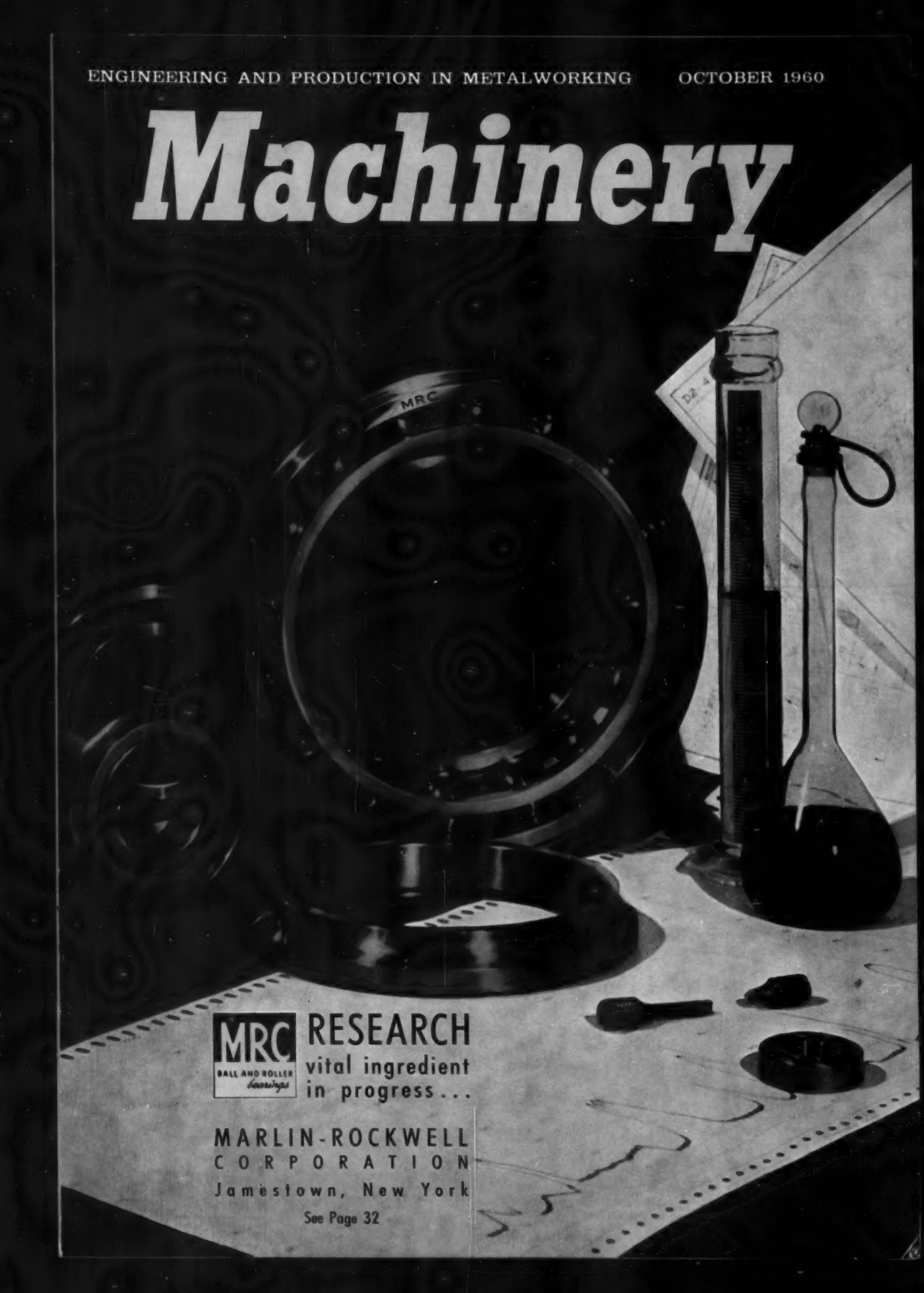
ENGINEERING AND PRODUCTION IN METALWORKING OCTOBER 1960

Machinery



See Page 32

Did you see Heald's NEW Model 171A Internal?

It's **LOADED** with new features for better production and easier servicing!

1. **Cross-slide Wheelhead Feed** assures maximum freedom from distortion under heavy roughing cuts—feeds faster and more accurately, with better size control.
2. **Right-Hand Feed Box** provides either constant feed or impulse feed that advances the wheel only at reversals of the table. Gives better finish and straightness on long bores. Manual override permits operator to fast feed or retract at any time.
3. **Infinitely Variable Compensation** for wheel wear, from 0 to .004", contributes to more constant size and longer wheel life.
4. **Front-Adjusted Wheel Dresser** is easier and safer to operate.
5. **Hydraulic Workhead Drive** provides greater range of speeds (from 50 to 1350 rpm) at the turn of a knob.
6. **Machine Base Contains No Heat-Producing Equipment** —hydraulic power and lube oil units are externally mounted, preventing thermal distortion and permitting easier access for servicing. Variable-displacement hydraulic system pumps oil only when it is *needed* to operate a cylinder or motor.
7. **Hydraulic and Electrical Cabinet** contains all hydraulic and electrical control mechanisms in separate dust-tight compartments—everything is easier to get at. Faster-acting miniature d-c solenoid valves speed-up cycles, last longer.
8. **Large Cabinet-Type Guards** cover entire work area and open automatically for greater safety, better coolant control and easier access for fixture changeover.

Heald Model 171A Internal Grinders are available in Size-Matic, Gage-Matic or Plain models for work with up to 8" swing and angular capacity up to 90°.

Ask your Heald engineer for complete information, or send for your copy of Bulletin No. 2-171A-1.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • Milwaukee • New York • Philadelphia • Syracuse

HEALD®

OCTOBER 1960

VOL. 67 No. 2

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BPA NBP

Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

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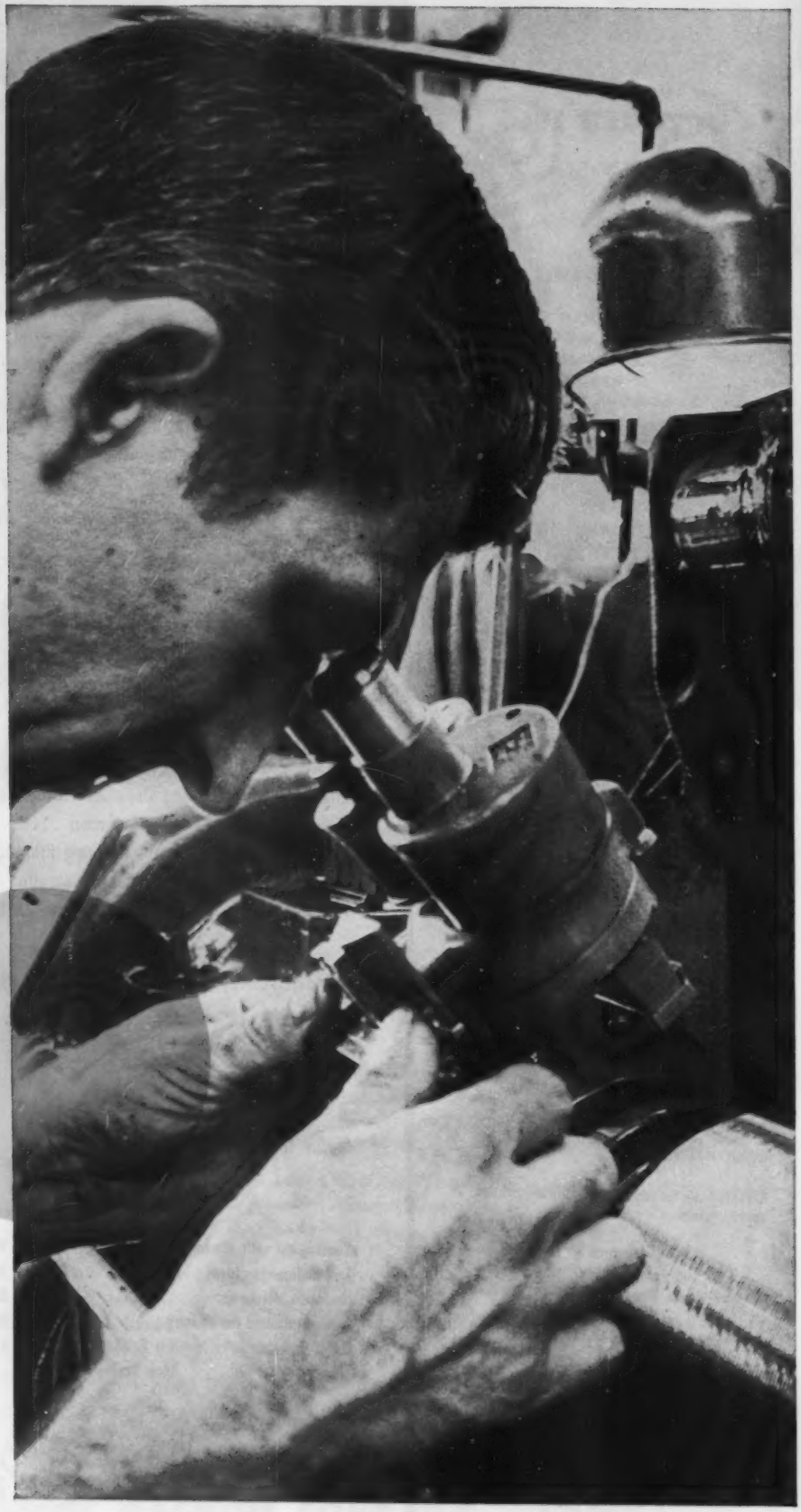


this man is looking for "BUGS"

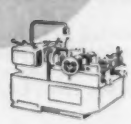
The "bugs" in this case are possible flaws in thread rolling dies. The inspector will reject the rolls if he finds any that are not perfect. All of our products must pass a comparable examination before being sold. As a result, our customers are assured of quality products producing excellent results.

For example, one of our customers reported they had thread rolled over 30 million screws with a LANROLL Thread Rolling Attachment and the Attachment was still doing a faultless job. Other customers report similar results.

Inspection is but one phase in our overall operation designed as a concentrated effort to produce quality threading machines and tools whether it be for Cutting, Rolling, Tapping or Grinding. Research and engineering develop the design which will meet the rigid standards of efficient threading. In production, the proper metals are selected to achieve the results specified in the design. Finally, the inspection, as in our illustration, insures that the products are perfect.

Perhaps your threading operations could use the benefits of our concentration on threading?

LANDIS *Machine* COMPANY WAYNESBORO • PENNSYLVANIA • U. S. A.
THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT


Threading Machines

Taps—Collapsible & Solid Adjustable

Centerless Thread Grinding Machines

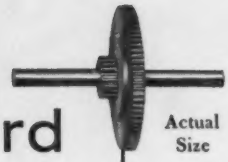
Thread Rolling Machines

Die Heads—Rotary & Stationary

Thread Rolling Tools

577C

For more data circle this page number on card at back of book



Actual Size

now you can check & record fine-pitch gear accuracy

at 1600 magnifications

on the No. 4 Fellows Red Liner

Now, the No. 4 Red Liner makes "composite" checks on the finest instrument gears with unbelievable accuracy and sensitivity. 1600 to 1 magnifications are obtained with the electrical recording system which gives a written, unbiased record for instant reading or for proof-of-accuracy files.

One report states — "11 teeth, 200 D. P. pinion backed up to a 100 tooth gear on a cluster, checked easily on the No. 4 Red Liner."

The job shown is 96 pitch with 22 teeth on the small gear and 80 teeth on the larger gear. The pinion shaft rides in vees in a turret-type fixture.

Fellows inspection units cover a range from the tiniest instrument gear up to some that are 24 inches in diameter.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

Investigate the full line of [illegible] *inspection equipment*

No. 4 Fine-Pitch Red Liner

No. 8M Red Liner

No. 20M Red Liner

No. 12H Lead Measuring

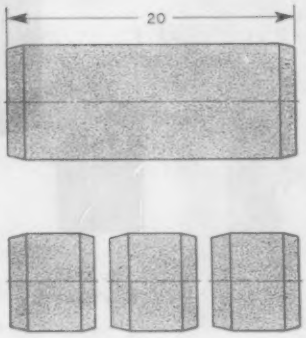
No. 12M Involute Measuring

THE PRECISION LINE

Fellows *Gear Production Equipment*

For more data circle this page number on card at back of book

New CINCINNATI FILMATIC No. 340-20 Centuramic, with 20" wide wheel. Powered by a 40 hp spindle drive motor, this Centuramic removes .007" stock in two passes at the fast thrufeed rate of 15 ft. per min. Details in catalog G-727D.



One 20" wide wheel Centuramic exceeds the thrufeed production potential of three 6" wide wheel machines . . . because nearly 60% more abrasive per minute contacts the work!

Automatic guardian of size—Cincinnati's new trend type ACRASIZE Post-Process Gaging.

BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

Exposition revealed many benefits...

MMT-PE

One replaces three—

Cincinnati No. 340-20 Centuramic Centerless cuts 6 thrufeed passes to 2

New ideas . . . new machines . . . new ways to reduce costs were evident everywhere at the Machine Tool Exposition. In the bustling crowds, perhaps you did not have time to ponder the demonstration of this precision grinding truism in Cincinnati's extensive exhibit: *reducing the number of passes sharply reduces the cost of thrufeed centerless work.*

There are two ways to reach this desirable end result. 1) The risky way, by reducing grinding stock to the danger point of inviting scrap. 2) The safe and sure way, by wide wheel thrufeed grinding on a CINCINNATI No. 340-20 Centuramic Centerless. This fine new machine makes heavy grinding stock disappear quickly. That's because the wheels are 20″ wide, and wide wheels can remove more stock per pass than narrow wheels. Of course, the entire machine, from the bed casting to the FILMATIC spindle bearings, is constructed to take advantage of the heavy duty potential of extra wide wheels. And the FILMATIC spindle bearings perform equally well under the dual requirements for heavy stock removal and light-as-a-whisper finishing passes.

Cincinnati attachments and accessories reduce costs still further. One of the newest is ACRASIZE Post-Process Gaging. It automatically gages the parts as they leave the grinding throat, and adjusts for variations in size.

You will find complete information on heavy duty CINCINNATI Centuramic Centerless Grinders in catalog G-727D. Ask for a copy today.

• ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®
GRINDING MACHINE DIVISION

For more data circle this page number on card at back of book

Now...grind with *predictable*

New Landis automatic plunge grinder gives

Landis automatic Type R Plunge Grinder tooled for grinding steering knuckle

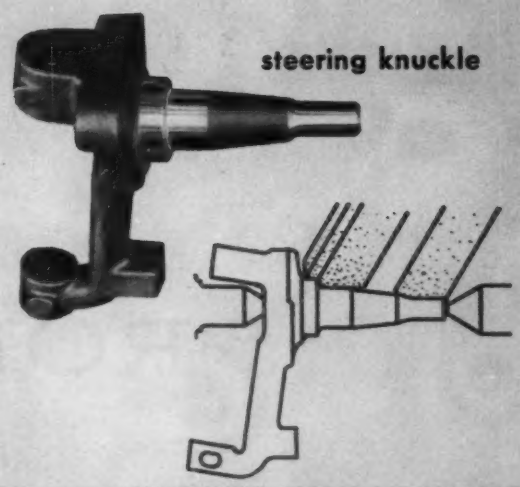
precision and production

consistent accuracy and higher output

Field reports of actual production figures

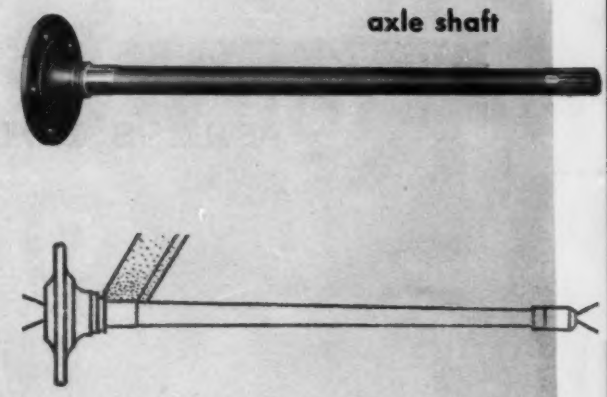
57% savings in cost per piece over former method

Part . . . . . steering knuckle
Net production . . . . . 210 parts per hour for 2 machines—1 operator
Operation . . . . grinding two diameters, radii and face surface at one time
Machine . . . . . Landis R Plunge Grinders
Material . . . . . 5147 chromium steel forging
Stock removal . . . . . .015"-.018"
Finish . . . . . Commerical
Specified tolerances . . . . size . . . . . .0006"
roundness . . .0002"
straightness .0002"



cost per piece cut 58% from former methods

Part . . . . . axle shaft
Net Production . . . . . 240 parts per hour for 2 machines—1 operator
Operation . . grinding two bearings, adjacent face and radius at one time
Machine . . . . . two Landis R Plunge Grinders, one operator
Material . . . . . 5147 chromium steel forging
Hardness . . . . . Rockwell 50-52
Stock removal . . . . . .015"-.020"
Finish . . . . . Commercial
Specified tolerances . . . . size . . . . . .0006"
roundness . . .0002"
straightness .0002"



LANDIS
precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

PROPOSAL
MULTI-SLIDES®
MULTI-MILLERS®
PRESS ROOM EQUIPMENT
US
PRODUCTS
U. S. TOOL COMPANY, INC.
AMPERE (East Orange) N.J.

PROPOSAL

FOR PROFITABLE PUNCH PRESS PRODUCTION

When the familiar orange and black U. S. Tool Proposal reaches your desk you are on the road to Punch Press Production that will please the most pessimistic.

There is no "high pressure" in a U. S. Proposal. Each one details our method of handling the material for the particular metal stamping project involved. You get the facts . . . you get the figures.

To insure positive Punch Press feeding, major press manufacturers often specify U. S. Feeds and U. S. Stock Straighteners as original equipment. They do so because they know that **Profitable** Punch Press Production depends upon the utmost efficiency, from coil stock to finished stamping.

Consider your present equipment — is it really set-up for **Profitable** Punch Press Production? If not, let us submit our PROPOSAL to help you achieve greater efficiency and economy in your stamping operations.

Send for Bulletins No. 85M and 151M.

Illustrated here are (reading from top to bottom): ACR-1642 U. S. Automatic Centralizing Reel; ACC-1648 U. S. Automatic Coil Cradle; SF-68A U. S. Slide Feed with Plain Straightener; PDS-16H U. S. Power Driven Straightener; PDSC-1648 U. S. Combination Cradle-Straightener.

U. S. TOOL COMPANY, INC.

AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

NEW Warner & Swasey

AS A PRECISION CHUCKING TURRET LATHE...

It is a heavy duty precision finishing machine with the power and ruggedness for preliminary roughing operations, too!

Warner & Swasey's New No. 2 MICRO-CUT Precision Chucking Turret Lathe combines into one machine the individual metal removal capabilities of first operation roughing machines and second operation precision finishing machines. As a result, more work pieces can be machined complete in a single chucking—job scheduling is simplified—concentricity tolerances are held easily.

With the No. 2 MICRO-CUT you can handle a wide range of small, complex, close tolerance work pieces in all materials—and do it on a production basis.

For full information on the new No. 2 MICRO-CUT Turret Lathes call your W/S Field Engineer, or write to The Warner & Swasey Company, Cleveland 3, Ohio.

SPECIFICATIONS

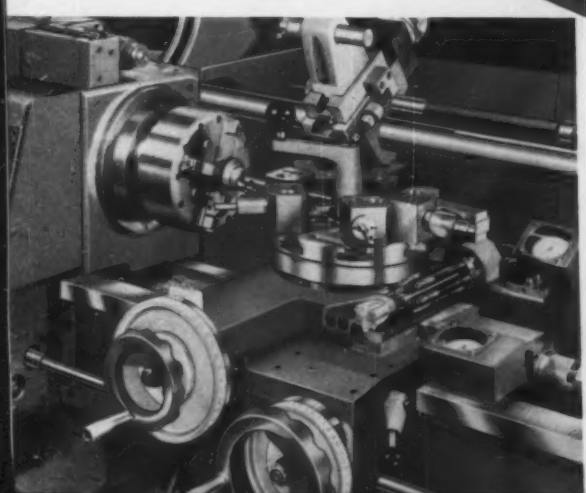
SWING ..... 14" Dia.

CHUCK DIA. ..... 6"

EIGHT STATION CROSS SLIDING TURRET
Max. cross travel ..... 5"
Six cross feeds ..... .0007 to .008
Six longitudinal feeds, .0015 to .017

SPINDLE SPEEDS
Three ranges of six, 50 to 3000 rpm

MOTOR – Two speed ..... 5/2½ hp



EIGHT-STATION CROSS SLIDING TURRET features a new Curvic Coupling mounting for the ultimate in precision alignment and rigidity under cut. Power feed pressures are uniquely adjustable for extra accurate, automatic "knock-off" in both cross and longitudinal direction. Tangential "T" slots for mounting turret tooling reduces setup time.

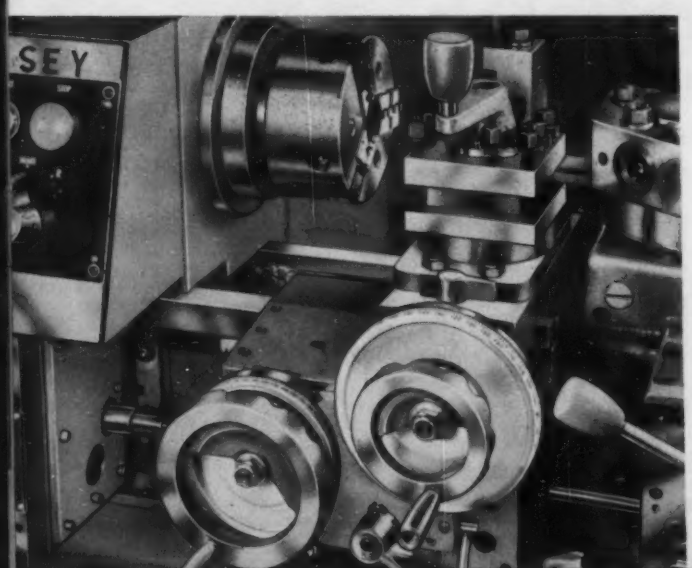
No. 2 MICRO-CUT

AS A UNIVERSAL TURRET LATHE...

It is the first 1¼" capacity turret lathe with full universal, power feed cross slide plus greater accuracy and heavier metal removal capabilities.

The new No. 2 MICRO-CUT Universal is a new kind of turret lathe, especially designed to handle close tolerance work up to 1¼-inch diameter—in all types of materials—in small to medium lot sizes. It is quick to set up, easy to operate, and is available for either bar or chucking work with plain or universal cross slide. The No. 2 MICRO-CUT is ideally suited to handle a wide variety of small diameter turning work in those fields where extreme accuracy, even with heavy metal removal, is essential to profitable operations.

To get the complete story on the new No. 2 MICRO-CUT Universal Turret Lathe call your W/S Field Engineer, or write direct to The Warner & Swasey Co., Cleveland 3, Ohio.



SPECIFICATIONS

SWING	Over bed	14" Dia.
	Over cross slide	6" Dia.
BAR CAPACITY	Round	1¼"
	Square	⅞"
	Hexagon	1⅛"
CHUCK DIAMETER		6"
POWER FEEDS		
	Six longitudinal	.0015 to .0173
	Six cross	.0014 to .016
SPINDLE SPEEDS		
	Three ranges of six	50 to 3000 rpm
MOTOR	Two Speed	5/2½ hp

UNIVERSAL CROSS SLIDE AND THREE JAW CHUCK. The No. 2 MICRO-CUT Universal cross slide, with square turret featuring a curvic coupling locating and locking mechanism, has power feed in both cross and longitudinal directions. Feeding pressures are uniquely adjustable through three ranges—from a "heavy" setting for rough cuts to a "light" setting for extremely accurate, automatic knock-off of precision finishing cuts.

Two and three-jaw, hand or air operated chucks are available for holding small castings, forgings and bar stock slugs.

You can produce it better, faster, for less...with a

WARNER & SWASEY

GRAY was the first to recognize the unparalleled advantages of the Norden System of Numerical Control when applied to a Gray Horizontal Milling and Boring Machine or a Planer Type Milling Machine.

Gray was the first to introduce this superior control that was jointly developed by Gray and Norden.

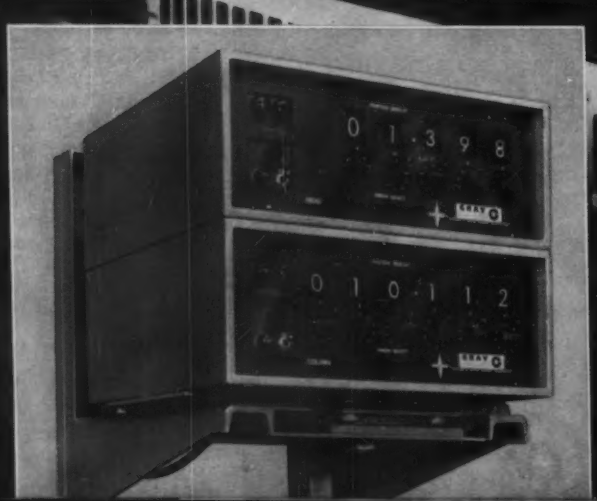
Consider these salient features:

- Read-out. A visual display clearly indicating at all times the exact location of a machine tool element.
- Zero Off-set. Ability to establish zero read-out on the display at any predetermined reference point on the work piece. Operator then reads drawing dimensions on display unit.
- Work to closer accuracies. Overall accuracies within .001". Unaffected by line voltage.
- Greatest productivity over prolonged period. Replaceable modular construction facilities quick servicing.
- Progressive steps to full tape control. Each phase may be purchased individually.

The G. A. GRAY Co. Cincinnati, Ohio

Horizontal Milling and Boring Machines
Planers • Planer Type Milling Machines

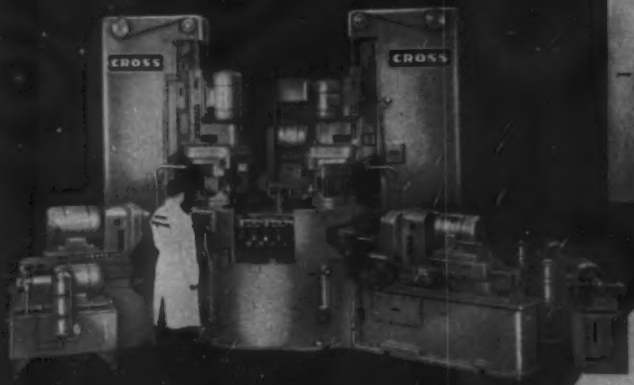
the perfect combination for



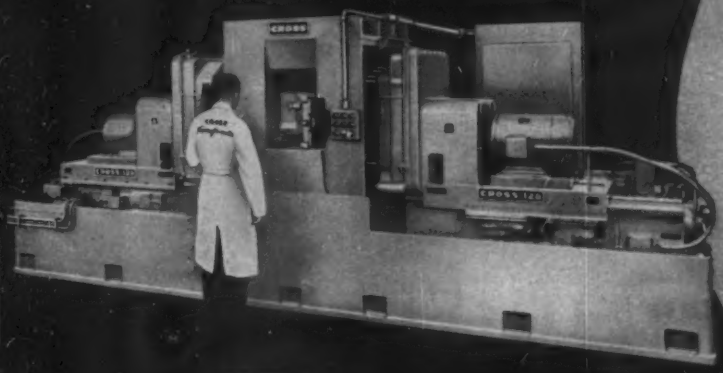
large non-repetitive jobs

6 ways to automate

Cross automation takes many forms . . . from the simplest low production machines to complex equipment for mass production.



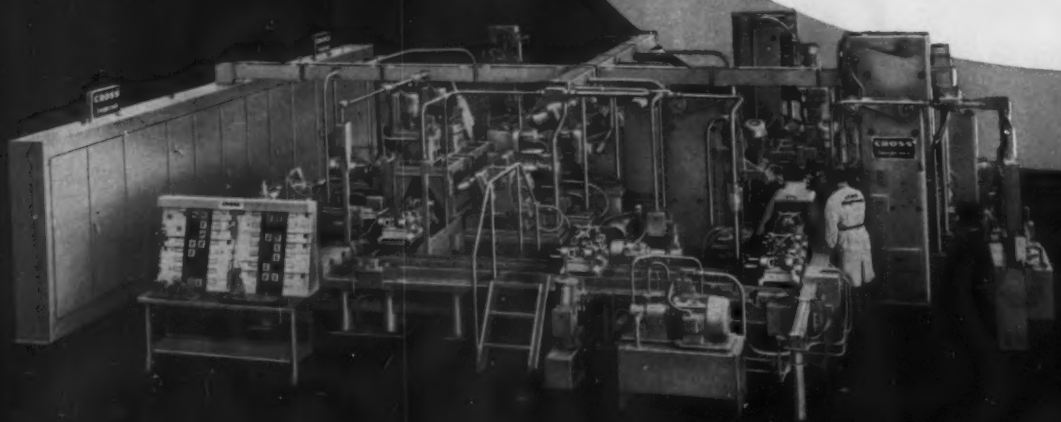
1 **CROSS SINGLE STATION MACHINES** exist in many configurations to combine operations.

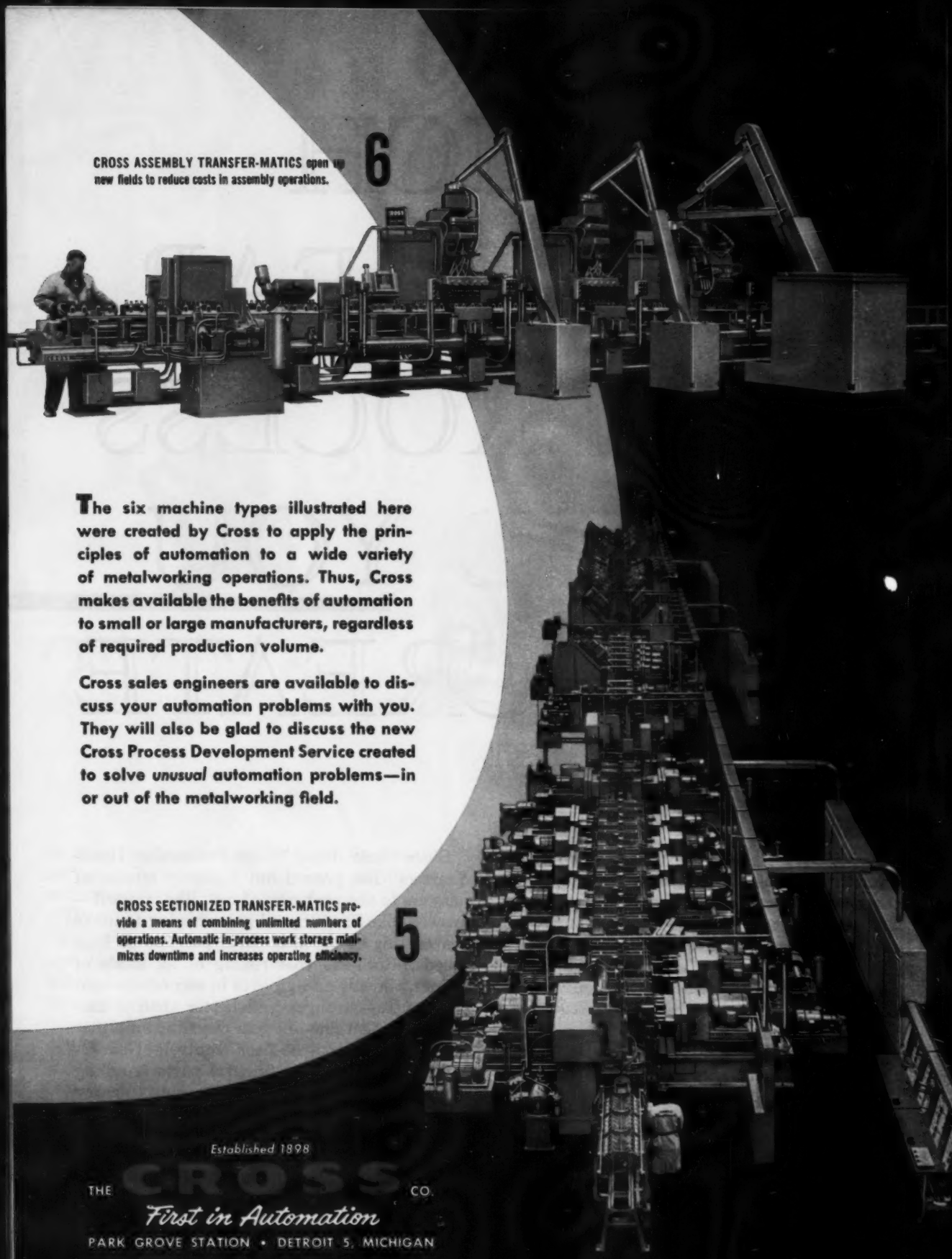


2 **CROSS DIAL TYPE MACHINES** provide multiple station performance with minimum floor space.

3 **CROSS TRUNNION TYPE MACHINES** are compact multiple station units that permit operations on opposite sides of the part.

4 **CROSS PALLET TYPE TRANSFER-MATICS** provide capacity for combining a large number of operations. Standard pallet fixtures handle irregularly shaped parts with maximum flexibility.





CROSS ASSEMBLY TRANSFER-MATICS open up new fields to reduce costs in assembly operations.

6

The six machine types illustrated here were created by Cross to apply the principles of automation to a wide variety of metalworking operations. Thus, Cross makes available the benefits of automation to small or large manufacturers, regardless of required production volume.

Cross sales engineers are available to discuss your automation problems with you. They will also be glad to discuss the new Cross Process Development Service created to solve *unusual* automation problems—in or out of the metalworking field.

CROSS SECTIONIZED TRANSFER-MATICS provide a means of combining unlimited numbers of operations. Automatic in-process work storage minimizes downtime and increases operating efficiency.

5

Established 1898

THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

WHICH NEW GEAR PROCESS WILL YOU HELP CREATE

Every new gear production process "we" pioneered in the last 3 or 4 decades—and there have been many—had its origin as a problem faced by one or more people like yourself—men who recognized the existence of a problem and came to Michigan Tool for the answer.

Lets go back to 1925 when automobile transmissions were so noisy that drivers couldn't hear themselves think over 30 miles an hour. Sales complained to management, management to engineering, engineering to manufacturing. They finally came to us and we put our engineers and research laboratory to work. You know the answer—gear shaving and the equipment that made quiet gears practical and economical.

Since those days, "Gear Production Headquarters" has poured out a steady stream of answers to the problems of men like yourself—answers like Shear-Speed gear shaping to make the cutting of toothed parts possible at high speeds; Roto-Flo cold rolling of all kinds of splines, threads and grooves in seconds instead of minutes—stronger and better than if machined; optical sine-line gear checking for either laboratory or on-the-floor control; Gear-O-Mation devices for automatic parts handling in process; double enveloping gearing to carry bigger loads with smaller gears; Ultra-Speed hobbing; hard gear finishing; giant shavers and hobbers to turn out gears up to 20 feet in diameter to almost unbelievable precision toler-

Michigan Tool Company

?

ances to make ship drives quiet to protect against submarines; grinding equipment to make even "spherical" gears.

To make some of the new processes work even better we created new tools, new coolants; new plastics for gear hones, indexing tables which divide a circle into 5 million parts accurate to a fraction of a second; even text and reference books to make gear designing easier.

You too must have a problem . . . large or small . . . about processes, machines or even tooling. Perhaps our experience has already provided the answer. If we don't have it, we'll go to work on it. Chances are we'll come up with it as we have so often before. It's worth trying and *your* Company will benefit.

7171 E. McNICHOLS ROAD • DETROIT • TW 1-3111

Plants in: Detroit, Traverse City and Manistee, Mich. and Windsor, Ontario.

Gear Production: The most complete line of equipment for gear production offered by any manufacturer.

Hobbers and Shapers for Job Lots
High Production Hobbers
Shear-Speed Gear Shapers
Roto-Flo Cold Forming
Shavers for gears of ½" to 200"
Internal and External Form Grinders
Sine-Line Gear and Tool Checkers
Gear Chamfering Equipment
Abrasive Gear Finishers
Mitco Quality Gear Cutting Tools

Automation Equipment (Gear-O-Mation Division): Engineering and manufacture of simple and practical equipment for automating a plant, a line, or a machine. Pre-engineered units for orienting, storage, loading, unloading, assembling, conveying, escapements, positioning, elevating, feeding.

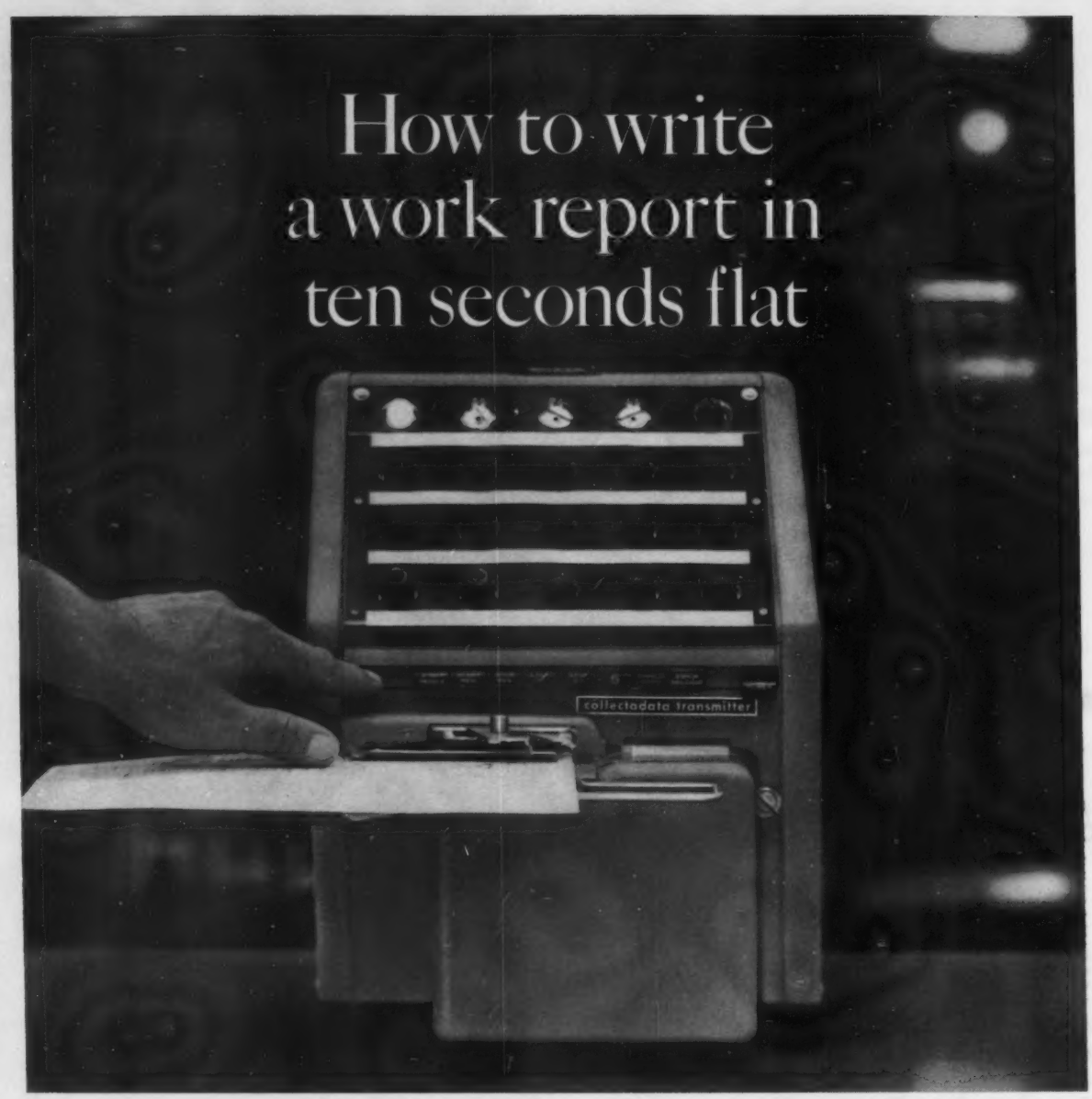
Form Grinding (Gear Grinding Machines Division): "Detroit" fully automatic form grinders for both external and internal contours—involute, cycloidal, spherical, straight sided.

Prototype Gearing (Enterprise Division): Spur, helical, bevel gears and splines for prototypes and in developmental quantities. Also contour form grinding, internal and external.

OTHER MICHIGAN TOOL DIVISIONS INCLUDE:

Cone-Drive Gears Division (double-enveloping worm gears, speed reducers, gear motors); Michigan-Lorenz Division (hobbers and shapers); Shear-Speed Chemical Products Division (coolants and cutting oils); Colonial Tool Co. of Canada Ltd. (cutting tools of all types).

How to write a work report in ten seconds flat



"Keeping track" is a fantastic problem in today's factory. Far and away the best (and cheapest) solution is a Friden Collectadata system. It works like this:

1) Work orders are issued in the form of tab cards or edge-punched documents.
2) When a job is completed, the worker puts his card in a Collectadata transmitter and touches a button.
3) The Collectadata receiver in the data center receives and automatically punches the information into a paper tape and records the time.
4) At day's end, the tape is processed—fed either into tape to tab card converter, or directly into computer to prepare a complete summary of work activity.

All plant activity — from receiving dock to shipping room — can be reported and recorded by this same simple method. For information, talk to your Friden Systems Man or write: Friden, Inc., San Leandro, Calif.

THIS IS PRACTIMATION: automation at the source of data with practical, sensibly priced equipment.

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PRODUCTION INCREASED TEN TIMES

One Gardner disc grinder increases production 10 times over old method

- replaces 8 milling machines
- slashes time requirements
- practically eliminates rejects

Gardner precision disc grinder holds close tolerances grinding thin aluminum plate 14" x 18" x 3/16".

Unusual accuracy produces aluminum plates to limits of .0003" for flatness and parallelism.

Send Gardner your prints for a practical solution to your production problem.

GARDNER

precision disc grinders

BELOIT, WISCONSIN

FROM CREATIVE CRUCIBLE: HIGH SPEED STEELS THAT MAKE BETTER TOOLS POSSIBLE

TO MAKE SURE A TWIST DRILL'S CUTTING EDGES ARE SHARP AND CLEAN, an inspector measures its chisel angle, point angle and lip relief under the powerful lens of a precision instrument. Continually-improved Rex High Speed Steels help produce the fine edges so essential in twist drills.

MORE HOLES PER DRILL *Today's twist drills meet new standards for hardness, toughness and strength– because of continually improved Rex® High Speed Steels.*

Drills, the most heavily loaded cutting tools in metalworking, are now meeting even more exacting requirements. A matter of economics accounts for the new standards: because, *the profitability of the automated equipment in which the drills are being used depends solely on their performance.*

Twist drills that meet customers' strictest specifications–for hardness and toughness, for strength and precision–are being produced right now. They're available because of the drillmakers' continuing research and skill – combined with Crucible progress in making better high speed steels.

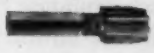
TWIST DRILLS made of Rex High Speed Steels consistently meet the drillmakers' exacting tests for hardness.

To produce the fine steels needed for twist drills, Crucible tool steel specialists now use the most advanced electronic instrumentation available. For example: they can record the temperature of the molten metal in the melting furnaces within 5 seconds. So, each heat is produced under identical temperature conditions.

Crucible specialists employ new techniques that also greatly improve deoxidation of the liquid steel. They use new ingot mold designs to minimize segregation. And they ultrasonically inspect every billet of Rex High Speed Steel before rolling or forging to ensure freedom from internal voids, flake, inclusions, etc.

For complete information on how Rex High Speed Steels can help make precision tools better, call or write the Crucible branch office or service center near you.

BETTER TOOLS, THROUGH BETTER STEELS. Constant improvement of Rex High Speed Steels ensures the increasingly better performance of hobs, taps, broaches and cutters — as well as twist drills.



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TAPS DIES GAGES

THE BALANCED LINE WITH 'BALANCED ACTION'

Metalworking men throughout industry recognize the precision of Winter Brothers 'Balanced Action' line of taps, dies and gages. From initial material selection to final inspection and packaging all Winter Brothers products are subject to the industry's highest quality control standards . . . a most important factor in determining ultimate on-the-job performance.

Winter Brothers Taps, Dies and Gages are stocked for your convenience by leading industrial distributors across the country. Specify "Winter Brothers" the next time you order.

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ARE RIGID, ACCURATE, ECONOMICAL

National Expansion Reamers with carbide tips feature solid bodies to provide greater rigidity and accuracy than conventional split-body expansion reamers. Expansion plug contact with the tool body extends well beyond the rear of the tips to assure uniform parallel expansion. Plug-type reamers are easy to adjust to .0001 of an inch. New cutting edges are exposed, clearance is automatically provided. Reamer servicing is virtually eliminated.

Shell Type Expansion Chucking Reamers are designed for low-cost, mass production reaming to close tolerances. They can be easily and accurately expanded to compensate for wear. When completely expanded, economical replacement shells are available from your local National Distributor. Check with National, too, for multi-diameter reamers incorporating expansion-type replacement shells.

The complete line of National carbide tools also includes drills, counterbores, milling cutters and end mills.

NATIONAL TWIST DRILL & TOOL ROCHESTER, MICH. U.S.A.

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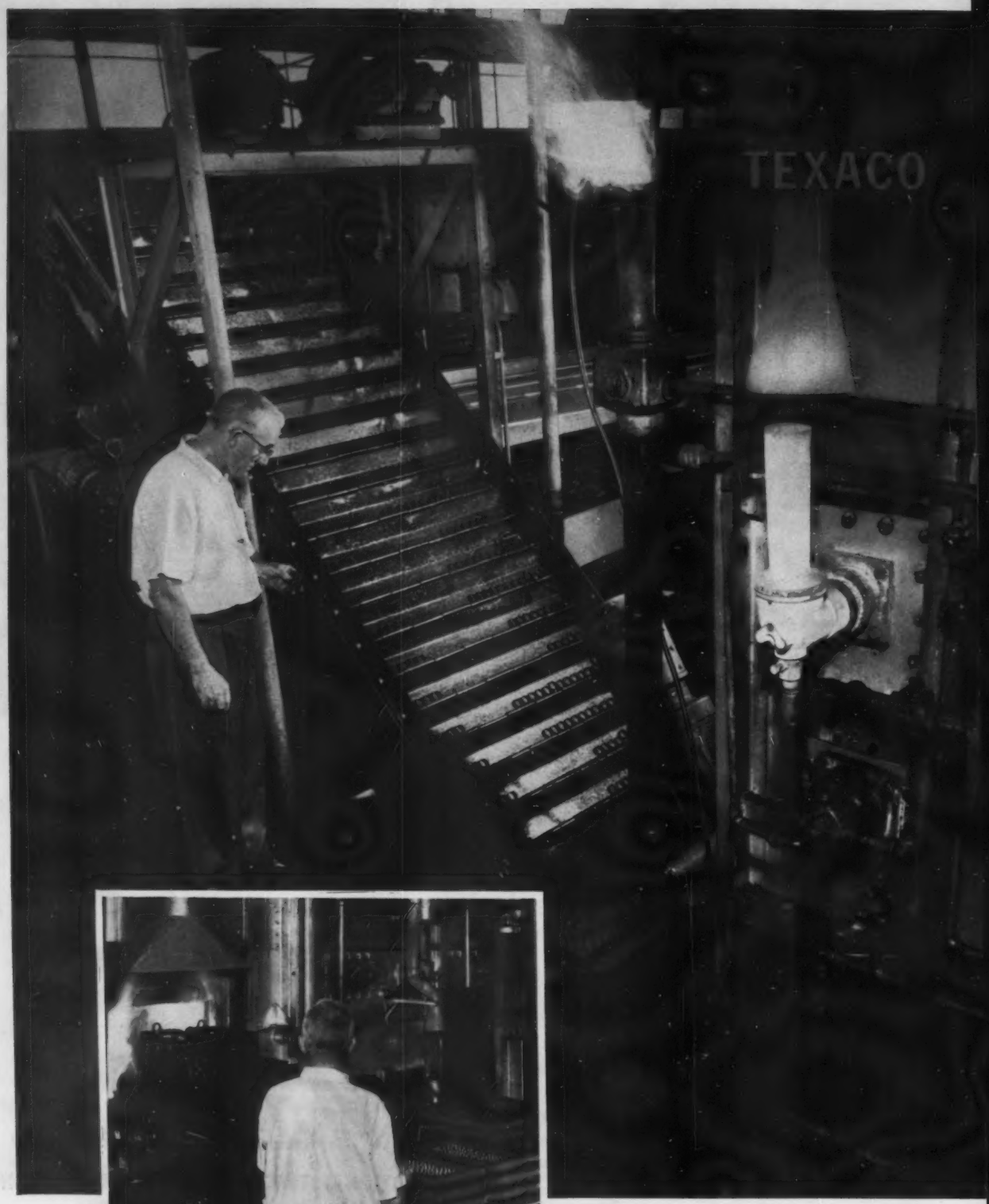


Photos taken at Hoover Ball and Bearing Company, Ann Arbor, Mich., show (left) parts going into heat treat furnace and (above) coming out of Quenchtex bath.

QUENCHTEX OILS GIVE UNIFORM HARDENING IN THE PIECE

with improved grain structure... no darkening of metal...longer bath life...

The proper choice of a quenching oil depends on the analysis of the steel being used and the hardness desired, among other factors.

A properly chosen quench for any given steel should remove heat fast in the high temperature range, and at a lower rate as the temperature drops through the low ranges where the metal becomes brittle and subject to stress. Because steels vary widely in analysis, Texaco offers three separate QUENCHTEX OILS—each with a different cooling curve.

The differences in cooling rate between the three QUENCHTEX OILS are functions of their composition:

- **QUENCHTEX 500**—a conventional or straight mineral oil of low viscosity;
- **QUENCHTEX 510**—a medium-speed oil blended with special additives;
- **QUENCHTEX 520**—a high-speed oil blended from refined paraffin base crudes plus additives.

GET THESE PROVED ADVANTAGES WITH QUENCHTEX OILS

- Stability at recommended temperatures
- High resistance to evaporation loss and chemical change which occur on contact with hot metals
- Resistance to oxidation which causes contamination, oil and metal discoloration, uneven hardening
- Low drag-out and evaporation loss for longer oil life and greater economy
- **Compatibility with other quenching oils. You can begin using Quenchtex now—regardless of the oil now in your tanks.**

A Texaco Metalworking Specialist will be glad to take a sample of the oil you are now using for testing by Texaco's Research Laboratory. A cooling curve will be run on the sample and the compatible QUENCHTEX OIL will be recommended for make-up. For further information contact the nearest of the more than 2,300 Texaco Distributing Plants or write: Dept. MA-51.

☆ ☆ ☆

Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

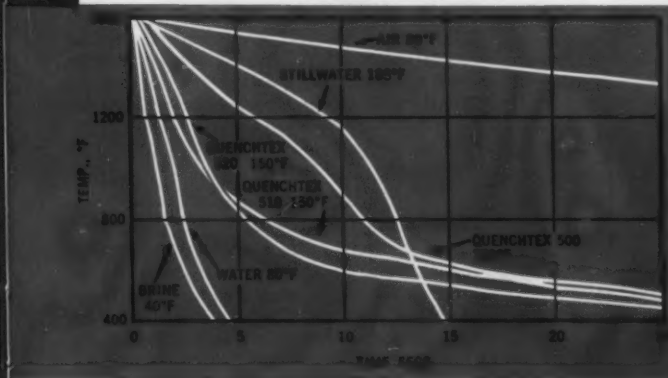


Chart shows cooling rates of several quenching media including QUENCHTEX 500, 510 and 520.

TEXACO MARQUENCH FOR HOT OIL QUENCHING

For products where full hardness combined with minimum distortion is required—gears, ball and roller bearings, bearing races, etc.—hot oil quenching with MARQUENCH can help reduce the number of rejects, increase product load capacities, and in some cases permit closer tolerances before quenching.

TEXACO

Throughout the United States
Canada • Latin America • West Africa

For more data circle this page number on card at back of book

For productiveness in the toolroom

MONARCH YEARS-AHEAD

Versatile as they come

The same basic machine is offered in two standard forms—with screw-cutting equipment as a Toolroom Lathe—without screw-cutting features, as a Manufacturing Lathe. Such additional items as the following improve productivity and enhance versatility.

Air-Gage Tracer
Automatic Cycling
Hydraulic Turret
Steady Rest
Follow Rest
Taper Turning Attachment
Collet Attachments
Air Equipment
Bar Feed Attachment

PRECISION PERFORMANCE

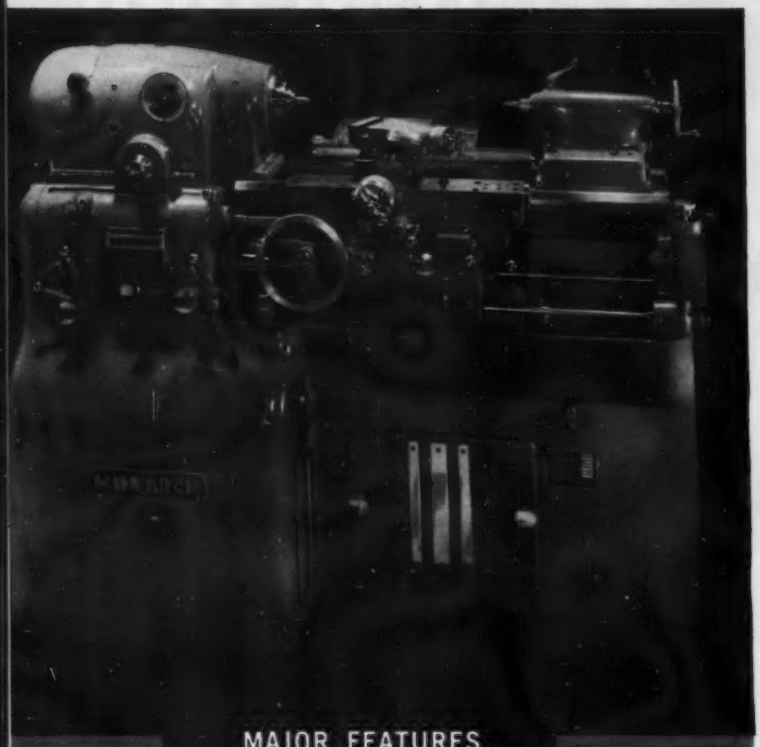
Here's a beautiful example of turning as both a science and an art. Just consider typical tolerances on this miniature gyro gimbal housing:

1. *Diameters A, B, C, E on same center line within .0002" T.I.R. and square to bore D within .0005" T.I.R.*
2. *All outside diameters concentric with inside diameters within .001" T.I.R.*
3. *Wall thickness E .030" ± .001"*
4. *Diameter A +.0002"; —.000"*
5. *Diameter C +.0005"; —.000"*

These units are externally and internally tracer turned to the above tolerances by Vee-Arc Corporation of Westboro, Massachusetts. Air-Gage Tracer equipped Monarch 10" EE Lathes are used—in conjunction with Vee-Arc Super-Precision Live Centers which are accurate within .000020" T.I.R.

for toolroom accuracy in production!

10" MODEL EE PRECISION LATHES



with many refinements PLUS 2 more horses

Any Model EE user will tell you it has long been the lathe of tomorrow. Now it's an even better machine with more power, more convenience, more productiveness.

For precision turning, boring, facing and threading in the toolroom this lathe has no equal. It's fully as proficient for such super-accurate manufacturing operations as required for small jet, missile, instrument, electronic and camera components.

Check the listing of major features; take a look at the job report and the many typical parts turned on this machine. Then, put it up to us to show you how the 10" EE can solve many of your turning problems with EEse.

THE MONARCH MACHINE TOOL COMPANY,
Sidney, Ohio.

If it can be turned
there's a Monarch to do it
better and faster

MAJOR FEATURES

- *5 H.P.* drive direct to spindle through multiple "V" belts, providing an infinitely variable speed range. No gears in the headstock.
- Standard speed range, 5 to 3000 R.P.M.; optional range, 6.5 to 4000 R.P.M.
- D.C. variable speed motor secures its power through an electronic unit which utilizes almost any source of A.C. This type of power supply minimizes vibration at all speeds, practically eliminates noise, improves speed regulation regardless of load and maintains better torque at the lower speeds.
- Spindle comes to dead stop in less than 2 seconds, attains full speed in less than 3 seconds.
- Automatic lubrication throughout.
- American standard Camlock spindle nose—for quick, rigid and accurate chuck and fixture mounting.
- Wide range of threads and feeds through totally enclosed gear box and end gearing.
- Cross feed and leadscrews induction hardened and ground.
- Flame hardened and precision ground bed ways for both carriage and tailstock. Bed all in one piece—no inserts.
- Easy, fatigue-free operation. Base design permits operator to work close comfortably, from standing or sitting positions.
- The only small lathe available with anti-friction bearing taper attachment.
- For thread chasing up to 100% faster, is available with exclusive combination of electric leadscrew reverse and variable reverse speed control.

Monarch
TURNING MACHINES

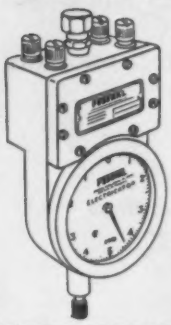
Lights show size category. Actual work size is shown on the dial.

faster gaging . . .

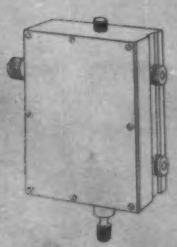
ELECTRIFYING RESULTS . . .

when you use the ELECTRICATOR

WETPROOF STYLE
(For each regular model)



DOUBLE UNIT MODELS
(Four limits, five categories)



ECCENTRICATOR
(For indicating eccentricity, runout, squareness)

There's nothing quite like the Federal Electricator — so easy to apply — so economical — so accurate . . . a Miracle Movement Dial Indicator and two-limit, spindle-actuated switch combined. Use it with tolerance lights in place of your dial indicator for faster, more accurate bench gaging. Use it together with a signal unit for fully automatic inspection or automatic machine or process control.

The Electricator is a high precision unit — switching accuracy is better than 50 millionths on all models. Voltage across the switch is extremely low and switching current is in the order of one milliampere. Therefore, arcing and pitting of contacts is eliminated and accuracy is reliably maintained. The Electricator is calibrated, so it requires only one master.

All Electricator models incorporate the new Federal Miracle Movement which is so wear-resistant . . . so shock resistant . . . you will probably never have to repair or replace it. Six regular models are immediately available from stock. Four different graduations — .0001", .00025", .0005", .001". Prices from $75.

The switching portion of the Electricator is available as a separate unit to operate tolerance lights and/or provide control limits without indicating actual size.

The Federal Eccentricator, a similar type of high precision unit, indicates eccentricity, runout, squareness, etc., *without* being influenced by normal piece-to-piece variations in size.

For more information, write . . .

FEDERAL PRODUCTS CORP.
61210 Eddy Street, Providence 1, R. I.

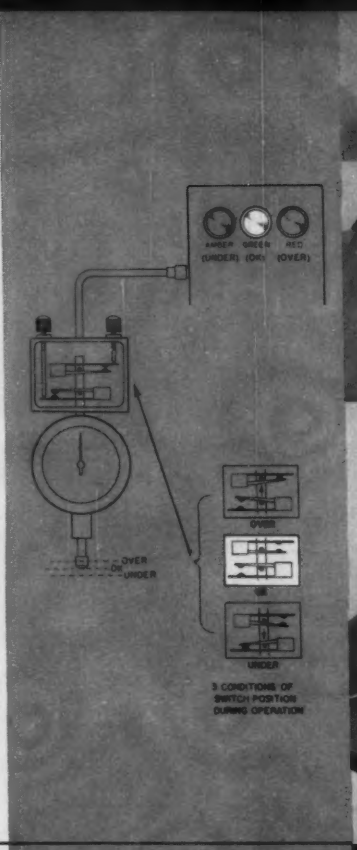
Ask **FEDERAL** *First*

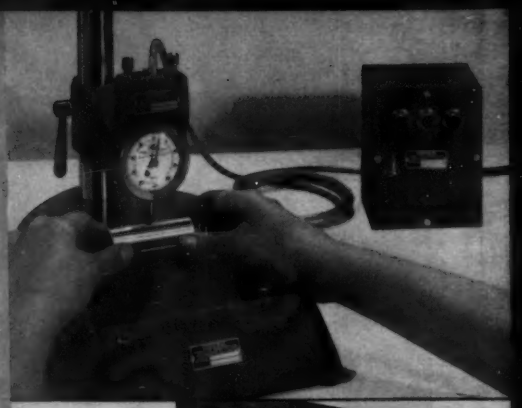
FOR RECOMMENDATIONS IN MODERN GAGES . . .
Dial Indicating, Air, Electric, or Electronic—for Inspecting, Measuring, Sorting, or Automation Gaging

FOR HIGH SPEED BENCH GAGING
(Single or Multiple Dimensions)

It's easy to install the Electricator in place of the dial indicator on your present comparator when you need greater speed. The Electricator eliminates having to make borderline decisions so you get more reliable results . . . and faster results . . . using less skilled help, and with less operator fatigue. Many concerns have up-graded their manual gaging this economical way with great success.

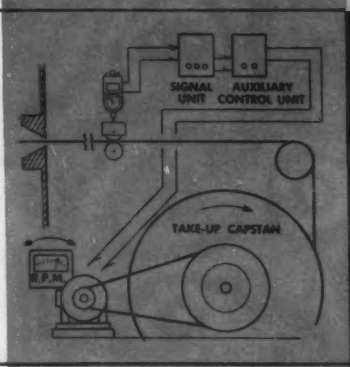
The Electricator offers the most economical way to make multi-dimension checks rapidly and reliably. The signal lights on its control panel instantly show the operator whether the piece is within tolerance or not. No need for operator to look at a group of indicators one by one in order to determine acceptability.

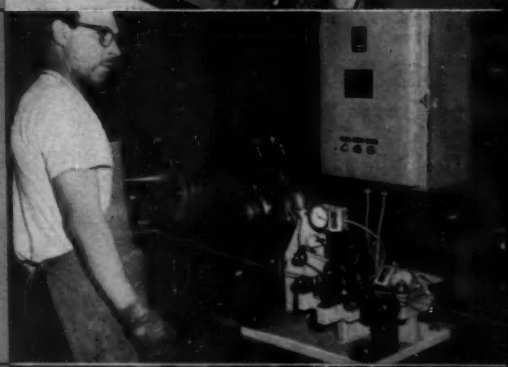




CONTINUOUS PROCESS CONTROL

Because the Electricator is compact, it can be installed easily on most continuous processes to indicate size trend accurately so correction can be made *before* scrap is produced. In many cases, Electricator, working into appropriate signal unit, can be used to *control* size so process automatically produces within tolerance.

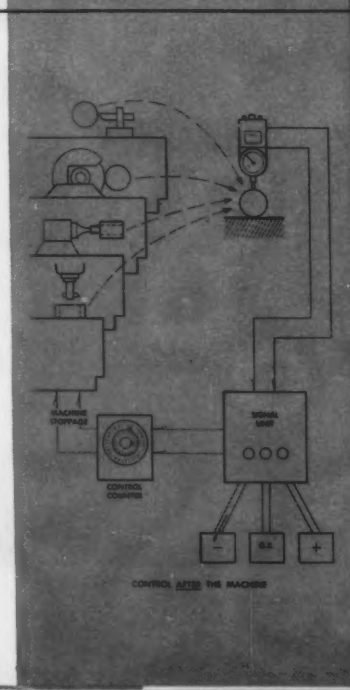


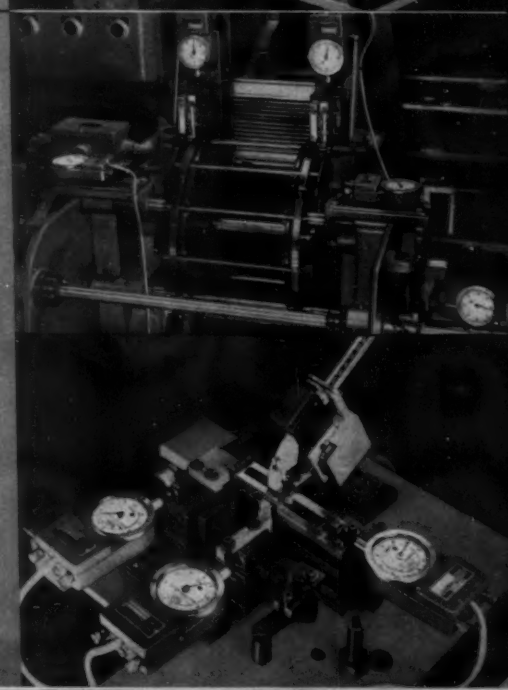


HIGH SPEED AUTOMATIC MULTI-DIMENSION INSPECTION AND MACHINE CONTROL

Electricators have rapid response — can gage and sort up to 6,000 pieces per hour, providing up to 5 sorting categories. Wide range adjustment of limits to suit tolerances. Use of low switching voltage and current provides high-reliability performance.

Electricator can also provide post-process machine control in addition to high-speed gaging and sorting. Using simple control counter, gage automatically stops machine when tolerance limits are exceeded.





RESEARCH

vital ingredient in progress

MRC Research, with skilled personnel, has achieved many firsts in the fields of metallurgical and manufacturing processes as applied to ball and roller bearings.

These advances enable MRC *to produce the highest precision bearings available today.*

MARLIN-ROCKWELL CORPORATION
Jamestown, New York

MRC
BALL AND ROLLER
bearings

PRODUCTION POINTERS from GISHOLT

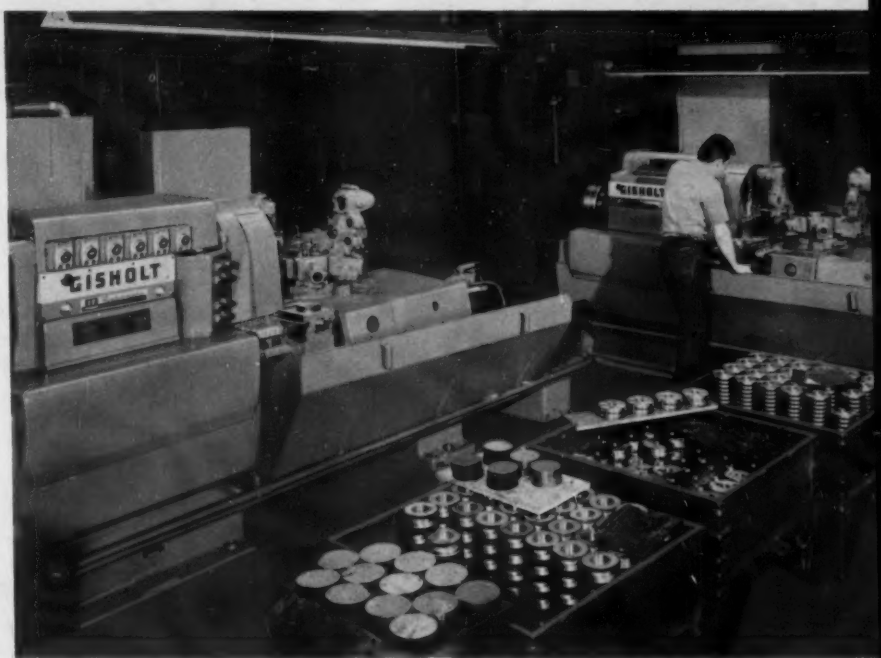
More cost-cutting IDEAS— to help you

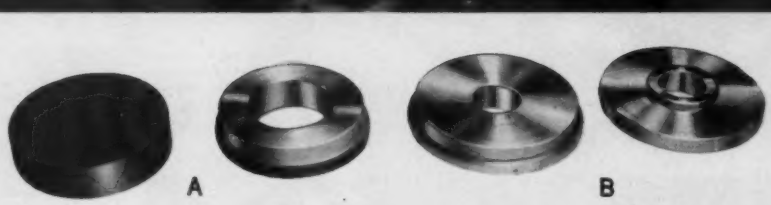
"PARTIALLY TOOLED" AUTOMATICS SHAVE 30 HOURS FROM 500-PIECE RUNS

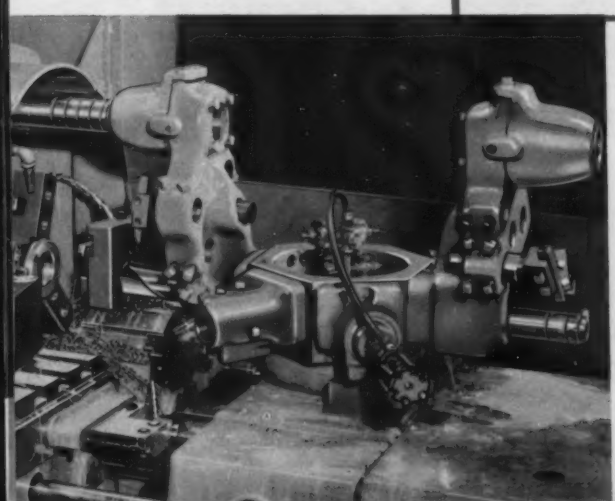
Sheldon Machine Co. switches to Fastermatics for faster setup and automatic machining

Fastermatic® Automatic Chucking Turret Lathes can turn a neat profit even on jobs requiring only a fraction of their tooling capacity; for example, the two steel gear blank jobs shown here. Sheldon Machine Company, Inc., Chicago, builder of precision lathes, milling machines and shapers, formerly used hand-operated ram type turret lathes for this work. Now one operator using two "partially tooled" Fastermatics is saving 30 hours on one job and 32 hours on the other—every 500 pieces. In addition, the automatic cycle assures optimum tool life and repeat accuracy — .0002" to .0003" in bores.

Savings result from both faster setup and automatic cycle. One Fastermatic, a 1959 model, (shown at left), features the new Gisholt FeeDial® control. This permits the operator to preselect his feeds for any turret face in less than one minute — saving 5 minutes per station over earlier models. He can select his feeds, speeds and functions in less than 15 minutes simply by flicking switches and turning dials. Manual controls cut time normally required for preliminary tool setting, trial cuts and final adjustments.







One man operating two partially tooled Fastermatics saves a total of 62 hours on jobs A and B from time required on manually operated ram type turret lathes.

Job A: steel apron clutch gear before and after first operation. (Setup shown at left.) Thirty-two hours saved in two operations on 500-piece lots. Only three hex turret stations used to drill, turn portion of O.D., finish-bore and chamfer. Rear and front cross slides rough- and finish-face. Time, 4.8 min. f.t.f.

Job B: steel apron compensating gear before and after second operation. Thirty hours saved in two operations on 500-piece lots. Fastermatic at right above, set up to handle second operation. Only hex turret stations 1 and 4 used to finish-turn O.D., finish-bore and chamfer. Flange finish-faced from rear cross slide. Hub finish-faced and chamfered from front cross slide. Time, 2.7 min. f.t.f.

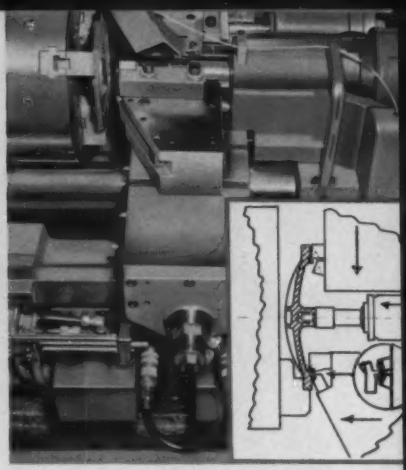
For information on the new Fastermatic with FeeDial control, circle or write in No. 729 on inquiry card.

COMBINED OPERATIONS CUT TIME 30% FOR ALMCO SUPERSHEEN

Motor-driven boring unit operates with standard tooling for extra efficiency

If you're machining parts similar to the cast iron stator and rotor cover plate shown, you might profit by studying this setup. Here a Gisholt MASTERLINE® No. 12 Automatic Chucking Lathe has a separate motor-driven boring unit operating with the standard tool slides. This permits completing two operations in one chucking. In use at Almco, Queen Products Division, King-Seeley Corporation, Albert Lea, Minnesota, this arrangement has improved accuracy, eliminated one operation and attendant work-handling, and achieved a 30% reduction in overall machining time.

Four different types of stator and rotor cover plates, in a wide range of sizes, are handled by one basic setup. Lots range from 1000 to 4000 pieces. The illustration and drawing show the setup for the most complex part. The cycle is as follows: Load work and chuck on O.D. at reduced pressure to eliminate possible work distortion; machine both faces from rear independent slide; front carriage tools bore at the base of the large O.D. face, size and undercut the pilot diameter and chamfer the edges. The boring unit operates with the front carriage. Carrying a multi-diameter cutter, it drills, co-bores, spot-faces and chamfers. F.t.f. time, only 1.5 min. F.t.f. times range from 1.3 to 1.5 min. on all parts handled, 30% less than before.



Note separate motor-driven boring unit actuated by front carriage, used to drill, co-bore, spot-face and chamfer. On forward movement of multi-diameter cutter and quill, wire automatically lifts guard, which drops back after operation is completed, protecting tool during loading and unloading. Layout at right shows how tools are located and the various surfaces they machine.

Throw-away tool tips and speedier boring unit permit proper surface speeds on all cuts — increase tool life 300%. Boring unit eliminates one operation.

For information on No. 12 Automatic Chucking Lathe, write in or circle No. 730 on inquiry card.

TRACING ON TURRET LATHES SPEEDS ROCKET ENGINE PRODUCTION

Battery of Gisholt Lathes averages 75% savings on wide range of complex parts

In equipping a new plant to produce prepackaged liquid propelled Guardian I and Guardian II rocket thrust units, Thiokol Chemical Corp.'s Reaction Motors Production Plant, Bristol, Pennsylvania, was faced with a number of tough problems. Work volume was low, but highly specialized; demand for low unit cost required minimum investment in equipment; maximum machine versatility was needed for quick change-over or retooling for design changes; a wide range of work required maximum machine capacity; close contract deadlines required quick machine delivery. Twelve standard Gisholt MASTERLINE® Ram and Saddle Type Turret Lathes were selected.

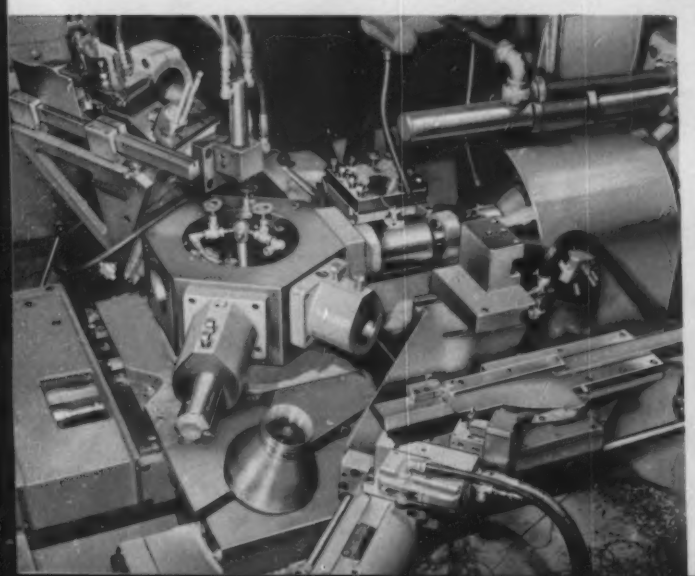
For contour turning, boring or facing, the lathes were equipped with JETracers to speed machining and eliminate chance of error. Included were JETracer® units for use on bridge-type cross slides, units to control a cross-feeding hex turret, turret-mounted slide tools and, in some cases, two different units on one machine. Because the work included such a wide variety of parts in an almost unlimited range of sizes, the Gisholt JETracers offered another important advantage: flat templates. These are quickly made, easily modified, and easily filed in minimum space for quick selection.

Here's maximum efficiency on short runs without high cost of special machines. JETracers and 12 Gisholt Turret Lathes average 75% savings.

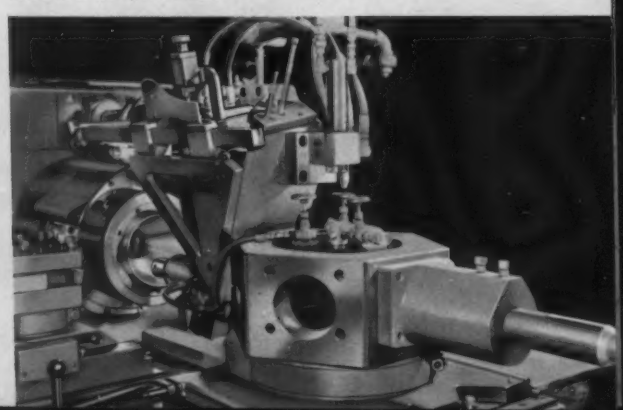
Gisholt MASTERLINE 3L with two JETracers for first operation on forged copper-alloy chamber nozzles. The end is faced from the front cross slide, then straight-bored from the turret. A turret mandrel supports the end during contour-turning by JETracer on rear of bridge-type cross slide, and grooving from front cross slide. Nozzle end is contour-bored by turret-mounted JETracer slide tool. F.t.f. time, 26.2 min.

For the complete story on this multiple-machine installation, write us for the magazine reprint "Turret Lathe Contouring of Rocket Engine Components."

Or write in or circle No. 731 on inquiry card.



Gisholt MASTERLINE 3L with turret-mounted JETracer slide tool, for second operation on chamber nozzles. Turret-mounted loader presses work into centralizing ring and holding fixture. Part is faced from front cross slide and the large I.D. is contour-bored with the JETracer. A 125 micro-inch R.M.S. finish is obtained, and tolerances of .002" are consistently held. F.t.f. time, 20.3 min.

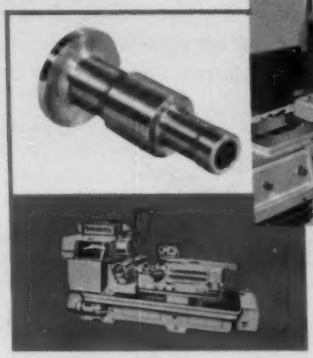


5 AR® SAVES 8 MINUTES PER PIECE FOR MURDOCK

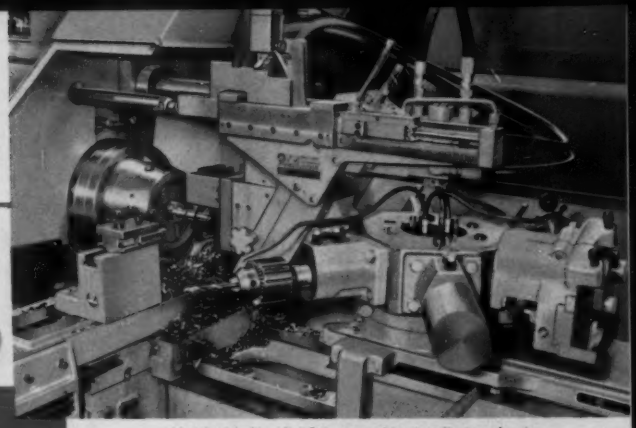
JETracer on hex turret operates as part of automatic cycle

Doing small-run bar and chucking work on hand-operated machines or expensive single-purpose automatics? You'll be interested in the setup being used by Murdock Machine & Engineering Co., Inc., Wichita, Kansas.

Doing contract manufacturing, this firm specializes in milling and turning. In their own reasoning, a Gisholt AR (Automatic Ram Turret Lathe) was selected for its versatility in job shop operations requiring fast setup and standard tools . . . for its capacity to handle a wide range of both bar and chucking work . . . and for the economies offered by the automatic cycle. For an example of how the AR provides cost-cutting performance, read the caption at right.



AR Turret Lathe with JETracer saves 8 min. per piece. Savings average 50% on all jobs. Machine sets up as fast as a hand-operated turret lathe, changes from bar to chucking work in 30-40 min.



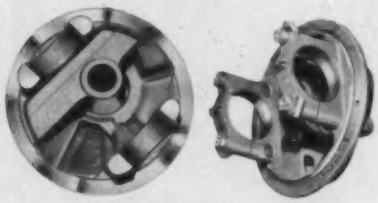
Murdock's No. 5 AR has an Air-draulic bar feed and a turret-mounted JETracer slide tool for contouring. Here's the cycle for a coupling shaft, shown, machined from 2"-diameter, hot rolled 4140 steel bar stock: stock feeds to length against turret stop; collet closes; hex turret box-turns two diameters; front cross slide rough forms two diameters and associated radii; turret-mounted JETracer automatically finish-traces from end face to O.D. of large flange end; hex turret drills, and rear cross slide cuts off. Then, cycle repeats. Time: 3 min., 15 sec. Previous methods, 12 min.

For information on No. 5 AR, circle or write in No. 732 on inquiry card.

SIMPLIMATIC® OFFERS "BUILDING-BLOCK" BENEFITS ON DIFFICULT PARTS

Independent slides positioned to suit the work for maximum efficiency

How would you machine the large O. D. face and the interrupted surfaces on these high-production parts? You could use a



Setup for a cast iron, 20" O.D. differential carrier. The tools on front, rear, and pedestal-mounted center slides operate simultaneously. Flange is rough- and finish-faced; register diameter is turned and chamfered, and four half-bearing faces are machined. Time: 5 min. f.t.f. — compared to 9.68 min. by previous methods.

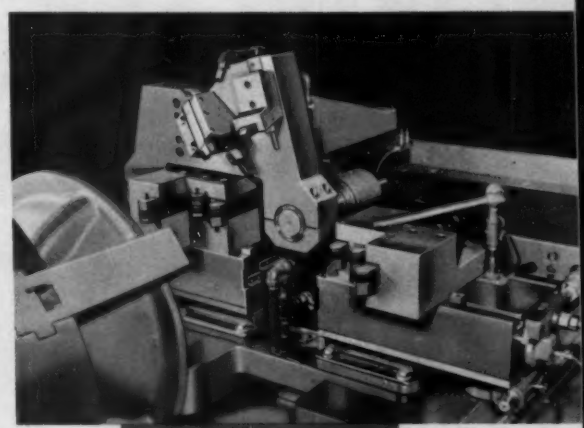
specially designed machine — or a standard lathe requiring a sequence of cuts. Or you could use the Gisholt MASTERLINE Simplimatic Automatic Chucking Lathe which offers the best of both machines— at *standard* machine prices.

This versatile machine is the essence of the building-block principle: a standard headstock and bed casting; and a wide, flat platen table that permits the use of standard front, center, rear or auxiliary slides with tool blocks where they are *needed* for each job. Slides may feed at different rates, permitting an unlimited variety of cuts and tool approaches. The screw-fed table can advance rapidly to position the tools or can feed to plunge tools to depth, turn an O.D. or bore, before slide movements begin.

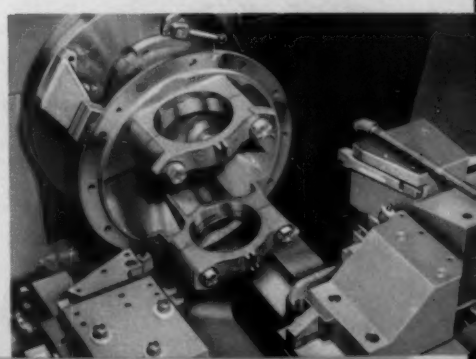
The captions tell how the two Simplimatic setups shown here are used by International Harvester Co., Inc.'s, Fort Wayne, Indiana, Motor Truck Plant, to handle the parts shown, above left.

Over five sizes are handled with no additional tooling. Simplimatic offers maximum flexibility plus capacity . . . does the work of special machines at standard machine cost.

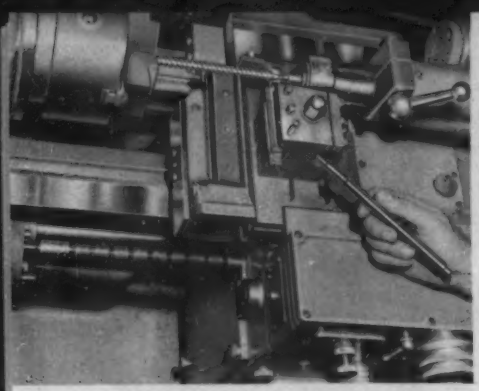
For information on Simplimatic Lathe, circle or write in No. 733 on inquiry card.



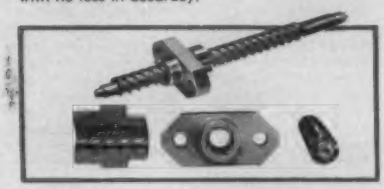
After a cap assembly is added, the work goes to a second Simplimatic. A spindle positioner speeds loading. Again, three standard slides are used — each positioned to suit the work. Register diameter is finished, and the four interrupted radii on the bearing cap ears are rough- and finish-turned and chamfered. Time: only 4.4 min. f.t.f. — compared to 7.59 by previous methods.



ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE



CRI-DAN "B" setup for 4-start adjusting screw, shown below. Note the stop roll at left of saddle. This permits cutting extra-length threads with no loss in accuracy.



Aircraft rudder pedal adjusting screw and nut assembly (for Lockheed Model C-130 airplane) shown at top. Bottom (left to right): adjusting nut, sectioned and end view to show internal 4-start thread; adjusting-screw end view to show 4-start thread.

CRI-DAN SAVES 65 MINUTES ON 4-START THREADING JOB

Single-point threading tools eliminate thread milling and expensive taps

Interested in cutting threading costs? Then you'll want to study this Gisholt CRI-DAN "B" Threading Lathe setup used by Orlando Machine Tool Co., New Smyrna Beach, Florida.

Two parts are involved: a long aircraft rudder pedal adjuster screw made of SAE 4130, heat-treated to 25-30 Rc, and a mating nut, made of aluminum bronze. Parts are used on the Lockheed Model C-130 airplane.

The screw requires a ½"-10 4-start Acme thread, with 1" lead, 5¾" long, .060" deep. Previously, this thread was milled in 1½ hours. Now a CRI-DAN "B" completes the part in only 25 min. f.t.f. The CRI-DAN is equipped with a 64-pass mechanism and a special stop roll that permits completing the 5¾"-long thread even though standard machine capacity is 3¼". After cutting part of the thread the saddle is re-located, using the stop roll. Accurate lead pickup is assured with no loss in accuracy, even on this tough, 4-start threading job. The single-point tool makes 60 automatic passes with .001" tool in-feed per pass, producing a 65 micro-inch R.M.S. finish.

The nut requires 32 passes, with .002" in-feed per pass. F.t.f. time, 15 min. Tap costs alone would have been $490. Compare this to the cost of single-point tools used by the CRI-DAN.

CRI-DAN "B" saves 65 min. per adjusting screw . . . uses cost-cutting, single-point tools in place of milling cutters or taps. Stop-roll feature stretches threading capacity with no loss in accuracy.

For complete information on CRI-DAN Threading Lathe, write in or circle No. 734 on inquiry card.

MISSILE GYROS BALANCED FASTER, MORE ACCURATELY ON GISHOLT HS

Air drive and special fixture simplify balancing of unusual part

If your work includes miniature high-speed parts or assemblies, you'll find Gisholt HS Balancers of interest. These machines handle armatures, aircraft and missile gyros, small spindles, turbines, etc. They accurately measure and locate unbalance causing movements as small as .000002".

An example is the piece shown here — a Rolleron Gyro manufactured by R. C. Allen Business Machines, Inc., Grand Rapids, Michigan. This unit is used to stabilize the Sidewinder aircraft-fired missile. Powered by air streaming past the stabilizing fins on the missile, the toothed wheel attains very high rotational speeds. Extremely close tolerances must be held to assure proper functioning.

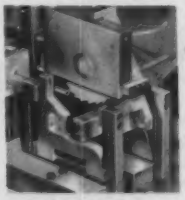
Shown on a Gisholt HS-2 Balancer, air drive accelerates the assembly to 8000 r.p.m. in just 5-8 seconds. Readings are taken in two correction planes. A light-dark finish variation on the toothed wheel triggers a photo tube pickup. This provides angle reference and indicates speed through a tachometer. Amount, in terms of drill depth and angle of unbalance is shown on separate direct-reading meters.

To maintain tolerances of less than 100 micro-ounce inches in each plane, the assembly passes through the balancer three times for a rough correction, final tolerance correction and inspection. Production —40 to 50 assemblies per 8-hour shift.

Gisholt HS-2 Balancer provides more accurate plane separation, angle indications and amount measurements, eliminating excessive correction cycles. Balancer is easily changed over to belt drive for other gyro parts.

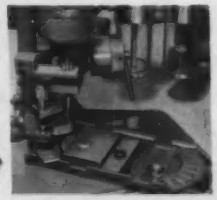
For complete information on HS Balancers, write in or circle No. 735 on inquiry card.

Gisholt HS-2 Balancer with fixture supporting Rolleron Gyro assembly. Note direct-reading amount and angle-of-unbalance meters at top right, and expanded scale tachometer below. Inset: Rolleron Gyro, with paper clip for size comparison.



Close-up of part in fixture. Note air-drive orifice at base of toothed wheel that accelerates the wheel to 8000 r.p.m. in 5-8 seconds, and maintains speed during location and measurement of unbalance.

Correction drill press has micrometer depth adjustment. Placed in a fixture, work is corrected in one plane, then turned and located at other end of fixture and swung under drill for second plane correction.



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MACHINE COMPANY

Madison 10, Wisconsin, U.S.A.

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

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Turret Lathes • Automatic Lathes • Balancers • Superfinishers ®

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"Rust Completely Under Control!"

CIMPLUS, rust-control specialist of the famous CIMCOOL family of cutting fluids, cuts special handling costs by more than $90 a week. (Company name on request).

2

SALES REPORT

firm makes textile machinery. They were having trouble grinding some cast iron and shell molded parts. Extremely high stock removal, using a soluble oil coolant.

They were experiencing (1) Considerable rancidity... (2) Unsatisfactory settling of grit and sludge...(3) Parts were rusting so badly that they needed special handling. They were dried in sawdust. Rust had to be sandblasted or worn off in tumbling machines.

We installed Cimplus at 1:75. Rancidity—Now no problem. Grit settling—Excellent. Rust—Completely under control, with no special handling needed. Cimplus is saving them better than $90 a week in labor costs alone!

George Stockwell
Boston Office

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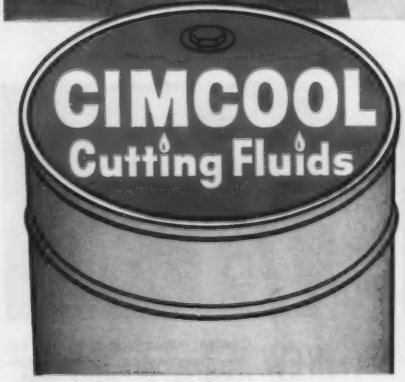

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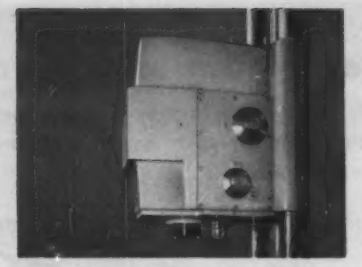
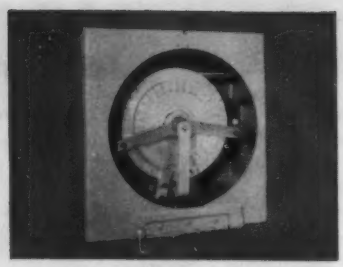
°Trade Marks Reg. U. S. Pat. Off.

NEW To control hone feed, simply adjust this dial on the set-up panel. Infinite adjustments are possible.



NEW Multiple speed control dial changes spindle speeds at a flick of the fingers.



NEW Reciprocation dial on Models 244 and 3010, and calibrated scale on Model 122, permit fast stroke control.

35 YEARS OF BARNESDRIL HONING EXPERIENCE

3 ARE WRAPPED UP IN THESE NEW HONING

Perhaps you saw them for the first time at the Machine Tool Show . . . a complete, new line of BarnesdriL high production honing machines. They're new from top to bottom . . . every feature exactingly engineered to cut costs and step-up production.

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We've incorporated 35 years of honing experience in them to give you machines that hone more economically than ever before.

If you'd like to know more, we'll be glad to send complete details. Of, if you prefer, a BarnesdriL sales engineer will call in person.

NEW Electrical controls are mounted inside the column of the machine to eliminate external panels.

BARNESDRIL HONING MACHINES

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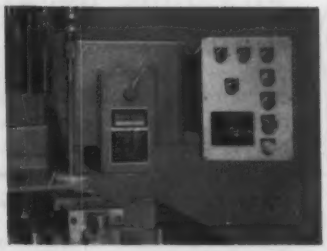
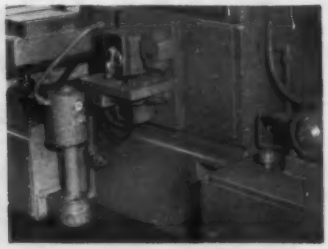
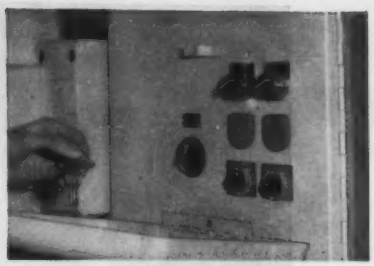
DETROIT OFFICE—13121 PURITAN AVENUE



NEW Operating control panel placed at shoulder height away from splash of coolant.



NEW Coolant pump is in the open for easy maintenance. Coolant reservoir is part of machine base!



NEW Positive protection against tampering with set-up controls guarded by lock and key.

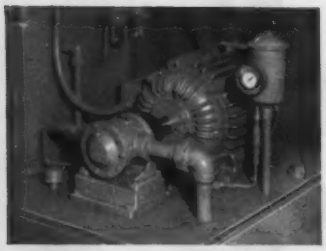
MACHINES

1

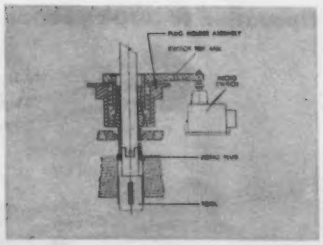
Model 244 hones bores up to 4" in diameter at full stroke. Choice of 3 stroke lengths, single or multiple spindles.

2

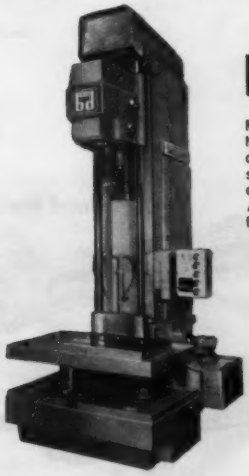
Model 122 hones bores up to 2" in diameter at full stroke. Available in 1 or 2 spindles and a variety of fixtures and tables.



NEW Easy-to-reach hydraulic pump and controls instantly accessible for periodic checking and servicing



Exclusive BarnesdriL Plugmatic bore-to-bore sizing maintains size consistency within .0002" on production runs!



3

Model 3010 hones up to 10" diameter at full stroke. Choice of 4 strokes. Adaptable for full automation

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You get these benefits...

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* **any external mounting to meet your requirements**

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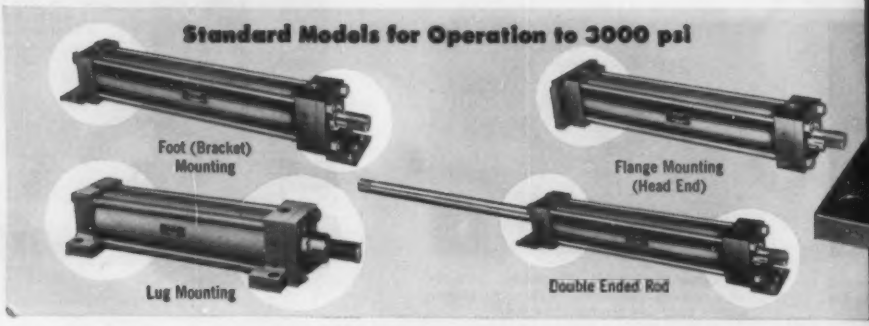
Typical of custom designs that can be furnished readily from Vickers new cylinder facility is this model built with extra rigidity and strength at both rod and clevis ends to overcome side loadings. For added corrosion resistance, stainless steel clevis pins, piston rods, retaining screws and grease fittings are used.

Standard Models for Operation to 3000 psi



Choose the cylinder "outside" that's best for your installation—Vickers offers you a wide selection of standard mountings plus an almost unlimited range of special configurations. Alternate rod end threads . . . straight thread port connections . . . extra barrel lengths for bearing support . . . are among many available options.

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- Cushions can be provided—either head, rod or both ends.
- Your choice of automotive step-cut piston rings for maximum life or low friction "T" rings for applications requiring minimum leakage. Full size cast iron piston for maximum bearing support with either type seal.
- Synthetic rubber wiper ring is standard—metallic wipers available.
- Two large wrench flats on rod are standard—additional flats available on request.
- Fully meet JIC specifications.

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8963

Standard Models for Operation to 3000 psi

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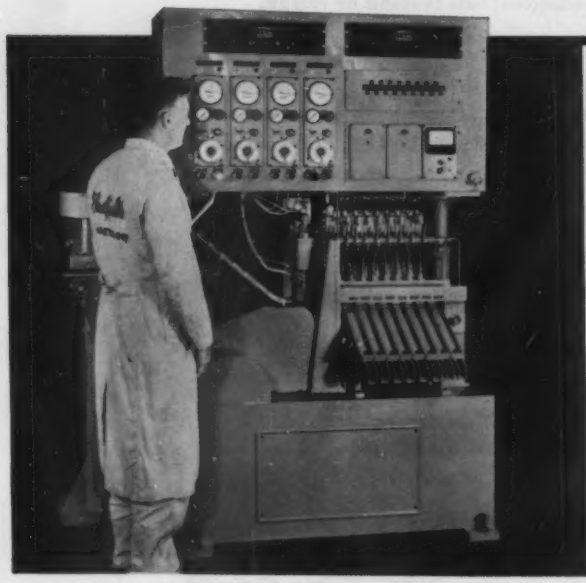
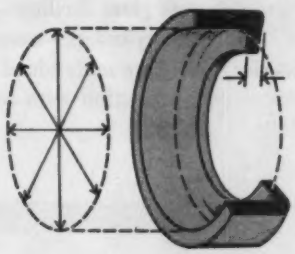
A **Sheffield sorter*** sorts 2000 rings an hour

2000 rings an hour a **Sheffield sorter*** sorts.

If a **Sheffield sorter*** sorts 2000 rings an hour

Where are the 2000 rings the **Sheffield sorter*** sorts?





*This Sheffield automatic gaging, classifying and segregating machine inspects up to 2,000 rings an hour for the Western Electric Company. It simultaneously measures inside diameter and flange thickness, classifies rings into 15 sizes plus out of tolerance, and rejects each size in its chute. Its speed and accuracy have resulted in appreciable manufacturing savings.

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AND A MAKER OF MEDICINE CABINET MIRROR FRAMES SAVES $10,000 A YEAR

As a result of a suggestion made by one of Revere's Technical Advisors, a maker of mirror frames for medicine cabinets has saved $10,000 a year on polishing costs alone. The suggestion was that, by changing to a brass of different grain size, the manufacturer might be able to save money on polishing costs and at the same time improve the quality of his product. (The 90° bend to which the mirror frames are subjected also had to be taken into consideration.)

Samples were made using a Revere Brass Strip with a smaller grain size as recommended by the Technical Advisor. Tests showed that, as a result of the change the manufacturer was able to realize a saving of 17¢ per mirror frame on polishing costs alone, with no increased costs in other operations, including the 90° bend. Based on the saving per frame this manufacturer has saved $10,000 per year for the past 4 years!

Here is still another example of how Revere's Technical Advisory Service working with the customer and the mill helped "fit the metal to the job," thus saving the customer money as well as improving product quality.

Why don't you take advantage of the extensive knowledge of Revere's Technical Advisory Service in "fitting the metal to the job?" It's entirely possible this service can save you money . . . help improve the quality of *your* product.

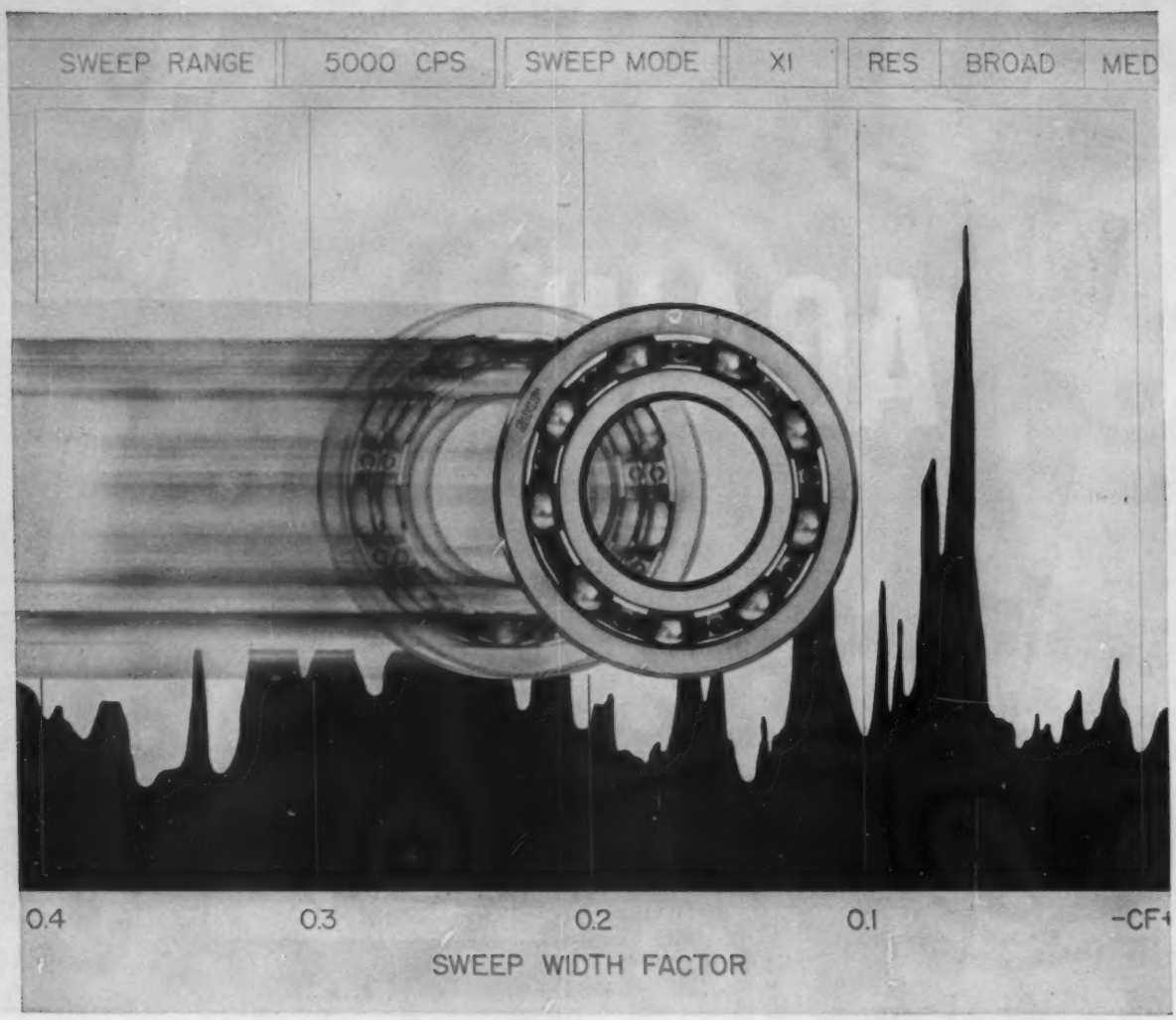
REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N. Y.

Sales Offices in Principal Cities. Mills: Rome, N. Y.; Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford and Plymouth, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb.

Distributors Everywhere.



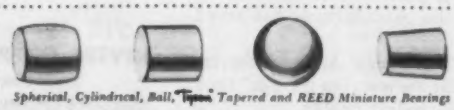
Now, SKF reduces the noise level of ball bearings by 50%!

New SKF ball bearings run twice as quietly as standard single-row deep-groove bearings – six times more quietly than bearings produced just two years ago.

They're designed especially for applications where noise is an important factor. Eight manufacturers, who use-tested them for over a year, now back-up their approvals with repeat orders.

Every bearing meets new, more critical standards. Each type and size meets special requirements for reduced vibration. Every ball meets very low waviness limits. Each cage meets critical standards for smooth, quiet performance.

SKF will make a comparison check of these improved bearings against the bearings you're now using. See for yourself! Just call the SKF branch office nearest you. 6013



Spherical, Cylindrical, Ball, Tapered and REED Miniature Bearings

EVERY TYPE—EVERY USE

SKF®

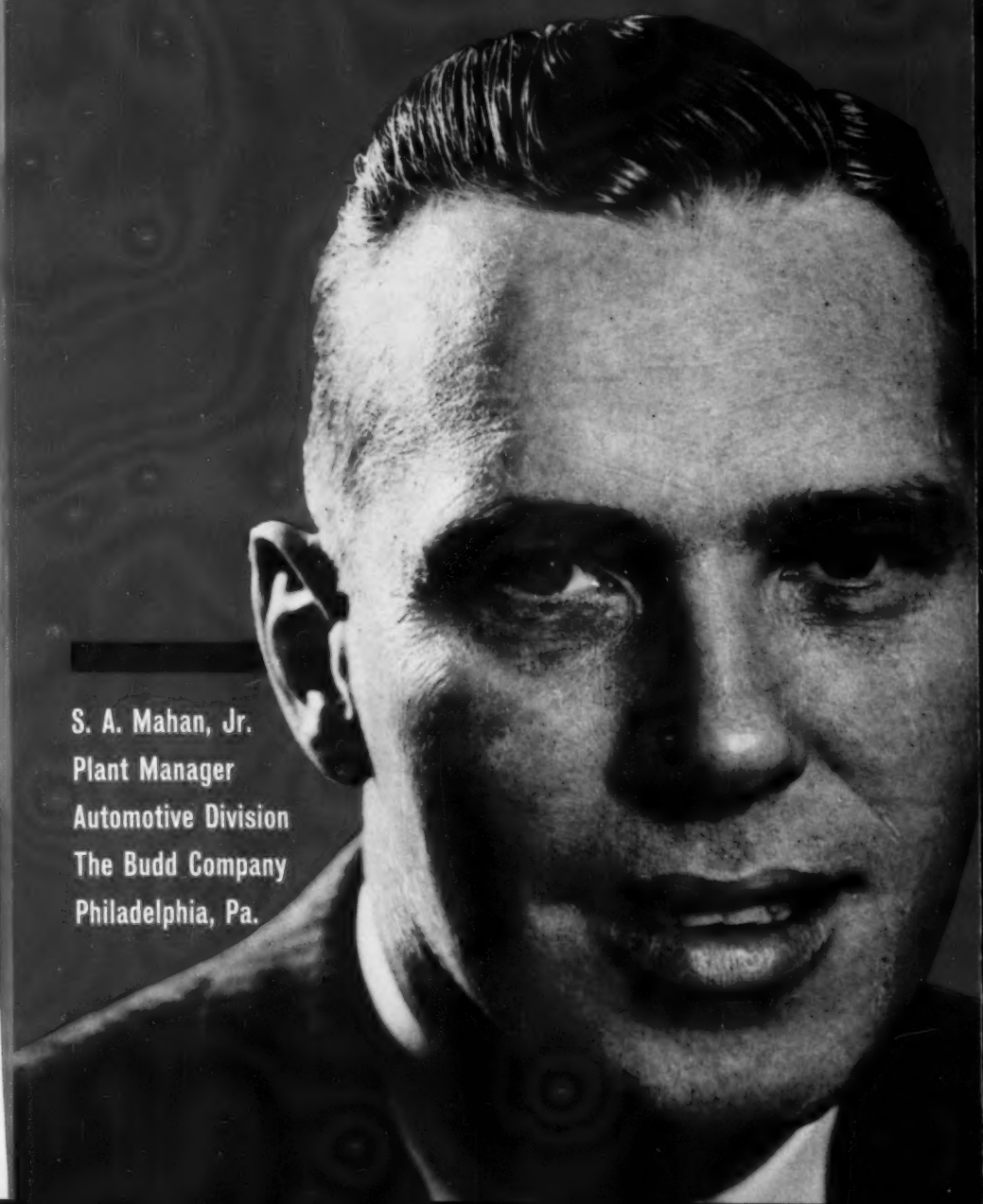
SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.

*REG. U.S. PAT. OFF.

"OUR FIRST TAPE-CONTROLLED MACHINE TOOL HIGHLY SUCCESSFUL

...A REAL BREAK-THROUGH IN MANUFACTURING EFFICIENCY."

OPEN FOR COMPLETE STORY



S. A. Mahan, Jr.
Plant Manager
Automotive Division
The Budd Company
Philadelphia, Pa.

GIDDINGS & LEWIS

ECONOMIC BENEFITS OF NUMERIPOINT* CONTROL AT THE BUDD COMPANY

The management of The Budd Company realized that tape-controlled machining in specific applications would be a means of improving service to customers and reducing manufacturing costs at the same time. As a result, a Giddings & Lewis Numeripoint-controlled horizontal was purchased for drilling, boring, reaming, and tapping die blank holder castings and plates.

The Budd Company — a major supplier of automobile components, maintaining plants in Philadelphia, Gary, and Detroit — also is one of the nation's leading die, jig, and fixture builders for the automotive, aircraft, and missile industries. In this tool business, lead time, scheduling, cost, and accuracy are critical factors.

The G&L machine has met the requirements beautifully. Here is how S. A. Mahan, Jr., plant manager, sums up the benefits derived from it: "Our Giddings & Lewis Numeripoint-controlled machine has been highly successful — has improved accuracy and saved money, reduced lead time, and helped us to meet tight schedules. We feel that this machine is just a start — that it has provided the foundation to go further into Numeripoint-controlled machines."

- Here are some of the reasons behind Mr. Mahan's statement as summed up by Budd's purchasing, shop, and programming personnel:

- Some j
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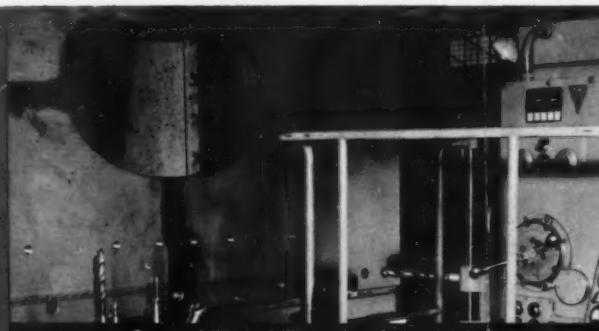
OPEN FOR COMPLETE STORY

*Giddings & Lewis trade name

G&L Numeripoint control is management control . . .

All the machining on a part is programmed by the process technician who "lays out" the piece by means of a written manuscript, establishes sequence of operations, and machine feeds and speeds. His written manuscript is typed out on a Flex-o-writer which punches the tape which operates the machine. Production rates and accuracies are predetermined.

Giddings & Lewis Model 50XB floor-type horizontal boring, drilling, and milling machine used at The Budd Company.



Center drilling, drilling, chamfering, and tapping in blan
and plates are accurate on center lines within ± .001"

Below — The operator has complete supervision of th
He needs do no physical checking with gages in order

GIDDINGS & LEWIS

me jobs that formerly took 29 hours on other type of machine, plus ten hours in yout, now require only 20 hours totally the G&L machine.

xpensive layout work and checking of yout are completely eliminated. The need r a crane and riggers to set up work on yout tables also is eliminated.

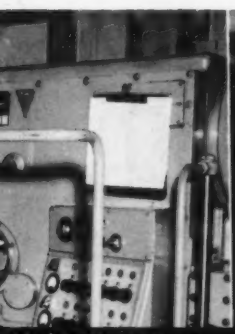
ecause die blank holder castings and ates now are accurately machined to .001" to tolerance from the same tape, rts go together smoothly on the assembly oor with consequent time savings and imination of reworking.

used to take as long to make costly xtures for some parts as it now does to achine the entire part itself.

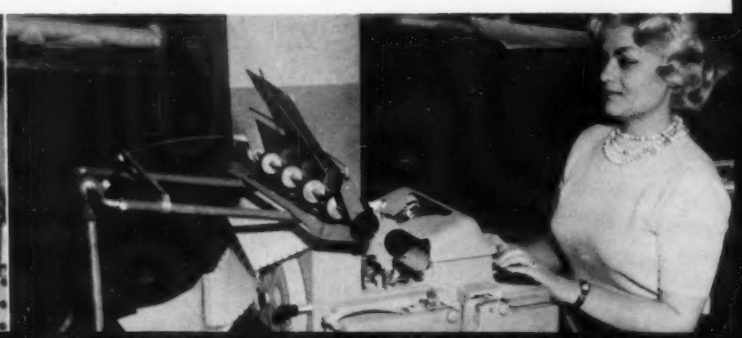
fter only three months' experience, the rogrammer can "tape" a part in a fraction f the time previously required to lay it out.

- Work can be planned more efficiently because programming is done well in advance of production.
- Workpieces with many common operations or hole patterns can share a master tape — only the differences need to be programmed individually.
- Once programmed, work can be accurately duplicated any time, with any machine operator, and with no lead time for layout involved.
- Each tool is handled only once; fast positioning permits all identical operations to be performed before changing tools.

The benefits that The Budd Company has secured are typical of those being experienced wherever G&L tape-controlled machines are in use. For a complete analysis of what this equipment might do for you, consult your local G&L distributor or write for information.

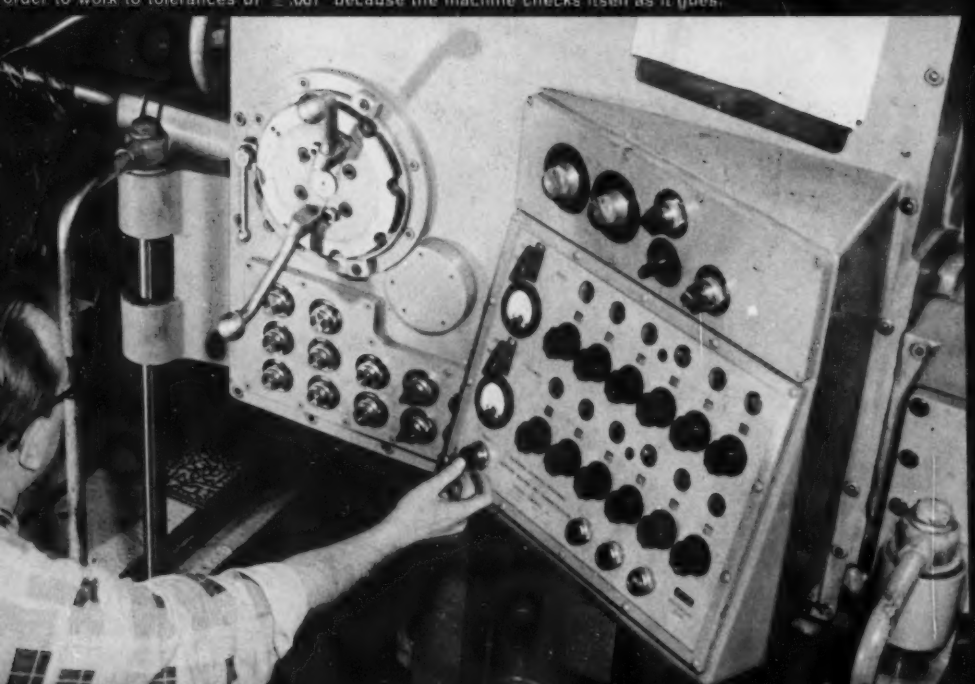


n blank holder castings .001" from end to end.



Manuscript and punched tapes for the Giddings & Lewis Numeripoint-controlled machine are easily produced on a Flex-o-writer.

of the machine through the control system — the readout system tells him the exact position of his tool. order to work to tolerances of ± .001" because the machine checks itself as it goes.



FIRST tape-controlled contour milling machine . . . *FIRST* tape-controlled vertical boring mill . . . *FIRST* tape-controlled vertical turret lathe . . . *FIRST* tape-controlled die sinking machine . . . *FIRST* tape-controlled horizontal boring, drilling, and milling machine . . . *FIRST* machine tool builder to develop and manufacture its own numerical controls . . . *FIRST* and only builder to provide programming and magnetic tape preparation service for customers . . . *FIRST* builder to offer both path and point control . . . *FIRST* builder to use tape-controlled machine tools in its own shops.

EXPERIENCE
TO HELP YOU INTO TAPE

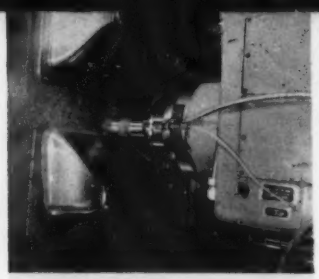
from the people who developed the first commercially available tape-controlled machine tool

The decision to go into tape depends upon a number of economic and manufacturing considerations. You can come with confidence to Giddings & Lewis to discuss these considerations.

Giddings & Lewis pioneered tape-controlled machine tools . . . has produced more major machines with numerical control than any other builder . . . has developed its own control systems . . . uses tape-controlled machines extensively in its own shops . . . and has established a numerical control research, development, testing, and programming center unique in the industry.

Giddings & Lewis machine tools are available with G&L Numeripath* magnetic tape continuous-path control or G&L Numeripoint* punched tape discrete positioning control, as well as with other makes of control systems. These machines are specifically designed and manufactured to be operated under tape.

For experienced answers to your tape-control questions, consult your Giddings & Lewis distributor or the factory. Literature available upon request. *Giddings & Lewis Machine Tool Company, Fond du Lac, Wisconsin.*


CONTOUR MILLING MACHINES

POSITIONING TABLES

VERTICAL TURRET LATHES

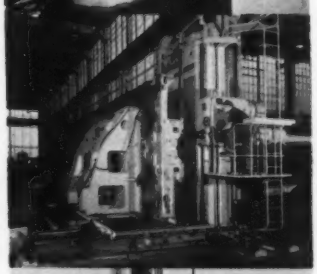

FLOOR-TYPE HORIZONTALS

TABLE-TYPE HORIZONTALS

VERTICAL BORING MILLS

GIDDINGS & LEWIS

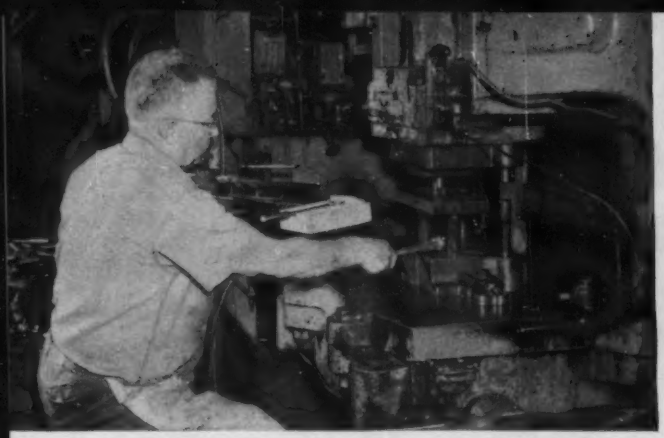
GIDDINGS & LEWIS

GIDDINGS & LEWIS MACHINE TOOL COMPANY, Fond du Lac, Wis.

Horizontal boring, drilling, and milling machines; vertical turret lathes; vertical boring mills; positioning tables; die sinking machines; contour milling machines; radial and upright drilling machines; planers; planer mills; numerical and tracer control systems; Davis boring tools.

*Giddings & Lewis Tradenames

H-202 Printed in U.S.A.



Teeth in ratchet head and socket openings are induction heated for hot forming without tears or ruptures. Over-heating of steel is avoided and decarburization is prevented. Unusual accuracy is attained and the grain structure of the metal remains unbroken.

Completely machined ratchet and socket blanks are heated and quenched in a series of salt baths to develop the proper relationship of toughness and hardness without decarburization or dimensional distortion.

A Push Button World at WILLIAMS

produces

Detachable Socket Wrenches

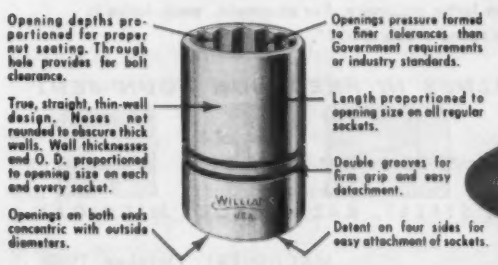
that have RESERVE STRENGTH for THE TOUGHEST JOBS

B-52 and S-52 RATCHET FEATURES

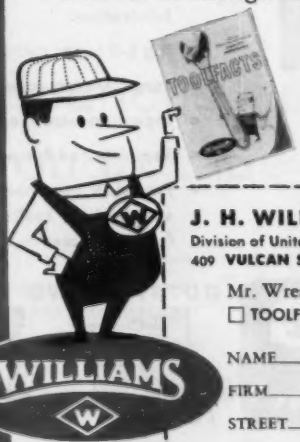
41 teeth give 82 tooth action requiring less than 4½° swing of handle for complete nut rotation.
S-52 "SUPERRATCHET" PATENTED
The harder the pull on the handle, the more teeth that come in contact.
Entire ratchet 50% stronger than U.S. Government requirements.
Length directly proportioned to weight distribution for ideal balance, comfort and leverage.
Soft knurling provides safe, non-irritating grip.

RETAINING RING
NEW... Four-Winged, Non-Slip Shifter Design
Rugged construction. No one part bears bulk of stress.
NEW... Single Unit Construction
Easily removed for cleaning, servicing and replacing
Stresses evenly distributed throughout entire mechanism.

DETACHABLE SOCKET FEATURES


Opening depths proportioned for proper nut seating. Through hole provides for bolt clearance.
True, straight, thin-wall design. Noses not rounded to obscure thick walls. Wall thicknesses and O. D. proportioned to opening size on each and every socket.
Openings on both ends concentric with outside diameters.
Openings pressure formed to finer tolerances than Government requirements or industry standards.
Length proportioned to opening size on all regular sockets.
Double grooves for firm grip and easy detachment.
Detent on four sides for easy attachment of sockets.

The unique combination of the latest automated equipment and design "know-how" produces a complete line of rugged, detachable socket wrenches which "bear up" under *every* stress condition encountered. Improved grain structure and precisely controlled heat-treating build up an unusual resistance to metal fatigue. These reserves of strength are hidden but guaranteed qualities built into all Williams' wrenches.



MR. WRENCH SAYS: "Get the Facts ... get TOOLFACTS ... new 24 page booklet on how to select, use and care for Quality Wrenches."

J. H. WILLIAMS & CO.
Division of United-Greenfield Corporation
409 **VULCAN STREET, BUFFALO 7, N.Y.**

Mr. Wrench: Please send me your new
☐ TOOLFACTS Booklet ☐ ILLUSTRATED CATALOG No. 304

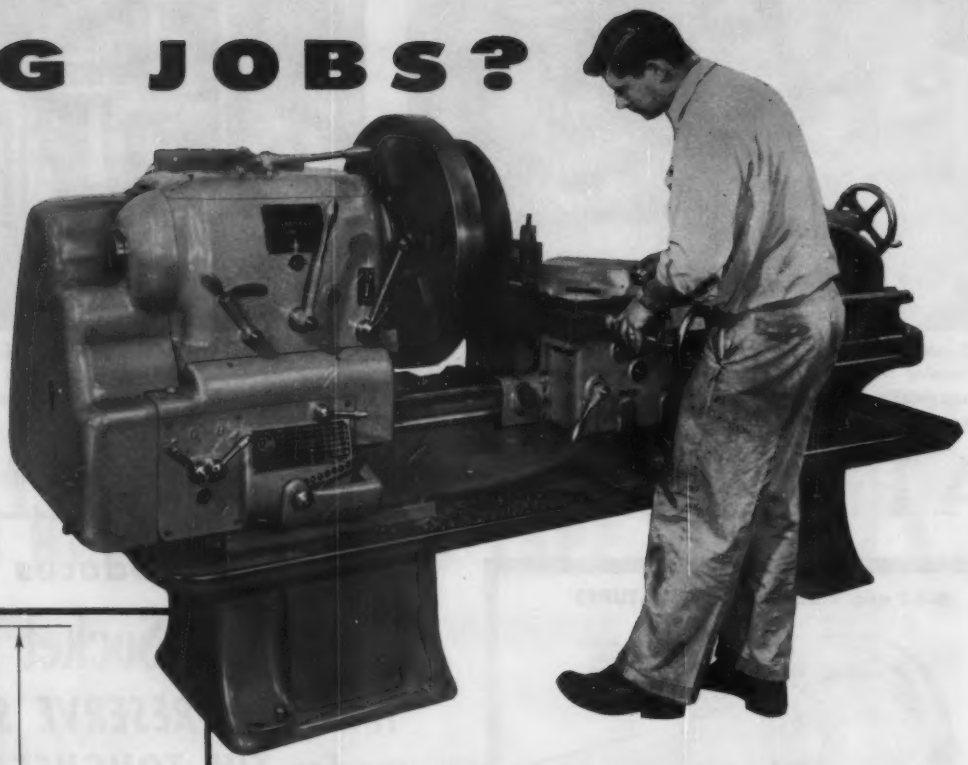
NAME_____ TITLE_____

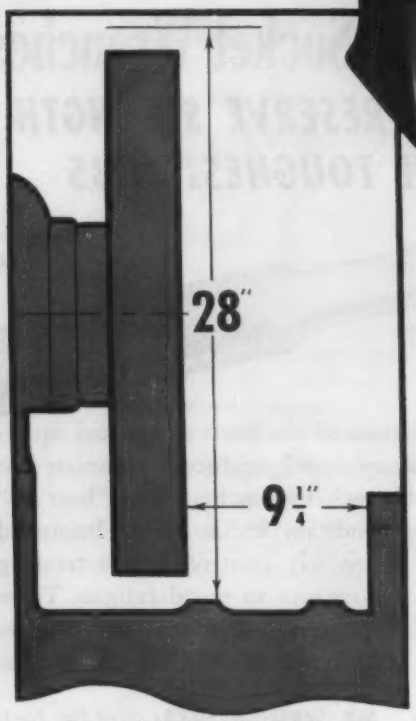
FIRM_____

STREET_____

CITY_____ ZONE____ STATE_____

BIG JOBS?





CLAUSING GAP BED LATHES' *EXTRA CAPACITY* HANDLES THEM IN STRIDE!

You get the needed capacity to handle those BIG jobs simply by removing the bed segment of this Clausing 17" gap bed lathe. Note the swing in gap—28". And the length of gap in front of face plate—9¼". Here, *for sure*, is a heavy duty, precision lathe that handles your big diameter work . . . in stride! Now, check its other "BIG CAPACITY" features:

- **3 1/16" hole-thru-spindle.**
- **All-geared headstock . . . shaved, hardened gears.**
- **Totally enclosed head and quick-change gear box, oil bath lubrication.**
- **Big L-2 taper spindle, hardened and ground.**
- **Large, Gamet tapered roller bearings with oil flow lubrication.**
- **Induction-hardened, precision ground bed ways.**
- **Separate rod for power feeds.**
- **Precision construction throughout to equal or surpass American standards of toolroom lathe accuracy. For example, each lathe is *factory-checked to turn round within .0001".***

Prices of the Clausing-Colchester 17" gap bed models, including 2-speed motor and Allen-Bradley controls, start at $5100; 13" at $2555 and 15" at $3580. Straight bed and profiling models also available. Write for complete information today.

349

CLAUSING
DIVISION OF
ATLAS PRESS COMPANY

OUTSTANDING VALUES IN PRECISION EQUIPMENT

10-110 N. PITCHER STREET, KALAMAZOO, MICHIGAN

Gleason Works announces automatic gear tester operation through tape control

Electronic tape control on Gleason Production Testers will make your bevel and hypoid gear tester operation an automatic process. Tape controls will allow you to automatically pre-set and vary test factors—direction of rotation, tooth bearing position, pinion spindle speed and brake load—in any sequence you wish.

Once you tape the test sequence, you can repeat it exactly anytime—for the next pair of gears or repeat the set-up months later.

Write us. We will be pleased to send additional information.

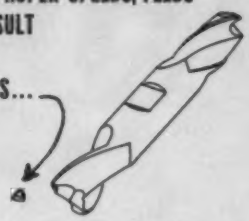
GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

CLIP AND FILE

END MILL TIPS YOU CAN USE

IMPROPER SPEEDS, FEEDS RESULT IN THIS...

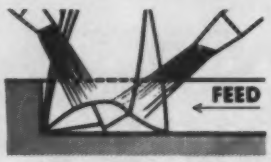


Improper speeds or feeds as well a failure to use adequate cooling methods lead to rapid, excessive wear on end mills. If end mill users would observe good cutting tool practices on these problems they could cut their tool costs and obtain better overall performance. Follow chart below.

SPEED AND FEED CHART (SFM)

Material	Speed
Aluminum and Magnesium	400-600
Brass	200-500
Iron—Cast and Malleable	90-100
Steel—Cast, Soft Alloy	70-80
Steel—Hard Alloy	30-50
Steel—Stainless	50-80

Feeds vary with diameter . . . from .0002" to .0005" small sizes to .003" up in larger sizes—per RPM.



CUTTING FLUIDS

You will get a better finish to your work and far more mileage from End Mills if you achieve the best possible use of coolants. No brief statememt can cover all situations, but best general advice is to use multiple streams —one on leading side of tool— one on back. Keep the flow heavy and steady.

GOT A PROBLEM?

Arrange a consultation with a Chicago-Latrobe Service Engineer. His experience can lead to a quick solution of your problem. Also — request comprehensive End Mill Speed and Feed Chart.

Best tip of all...

ASK YOUR DISTRIBUTOR FOR . . .

INDUSTRIAL DISTRIBUTORS — SERVING INDUSTRY ECONOMICALLY — THE RIGHT HAND OF PRODUCTION

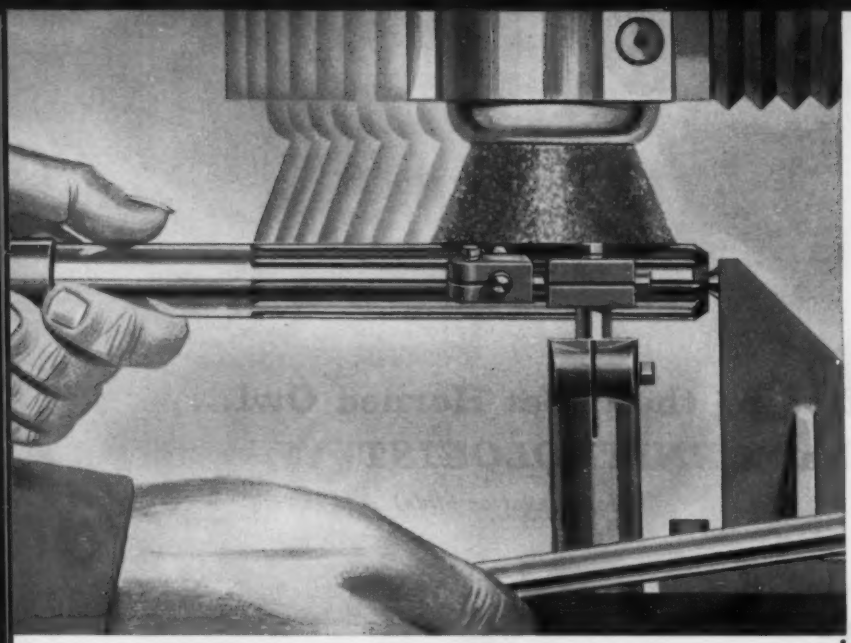
Chicago-Latrobe END MILLS

DRILLS • REAMERS • END MILLS
COUNTERSINKS • COUNTERBORES
CARBIDE TOOLS • SPECIAL TOOLS and
"LO-TORK" CHIP BREAKER DRILLS

Write Chicago-Latrobe or call your distributor for CATALOG No. 60 Sixty-eight pages of illustrated listings and specifications—including prices.

CHICAGO-LATROBE

428 West Ontario Street Chicago 10, Illinois

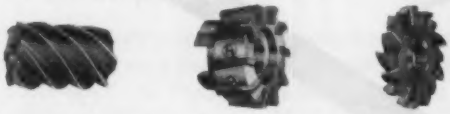


OLIVER "ACE" TOOL AND CUTTER GRINDER

Traverses the wheel—not the work!

You can grind tools and cutters more accurately with the Oliver "ACE" because the wheel is brought to the work, reversing the usual process. Abrasive dirt and grit cannot cause wear because the cross carriage is not in motion. The horizontal ram which supports the grinding head is fully enclosed–sealed against dust and dirt. Further accuracy is assured because the wheel is trued by a stationary diamond which provides a fixed grinding line. It is not necessary to reset the cutter to compensate for wheel wear.

The "ACE" is a tool and cutter grinder designed expressly for tool grinding–not a general purpose machine adapted to tool room work. It is simple to set up. All angles are obtained by direct reading. Operators stand in a natural position with the control lever in easy reach and the work in direct view.



Face mills, reamers, end mills, staggered tooth cutters, slab mills, spot facers–all cutters straight or spiral–are quickly, easily and economically sharpened with the Oliver "ACE". Both standard and heavy duty models are extensively used for sharpening carbide-tipped circular wood saws used in both woodworking and metalworking.

Write today for complete information. We'd appreciate the opportunity of sending a quotation.

OLIVER of ADRIAN

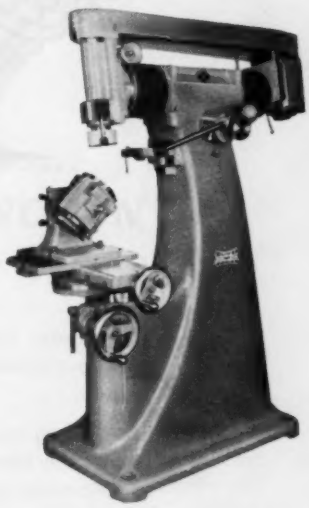
1410 E. Maumee St. • Adrian, Michigan

DRILL GRINDERS AND THINNERS–TOOL AND CUTTER GRINDERS–AUTOMATIC AND MANUAL FACE MILL GRINDERS–TOOL BIT GRINDERS–CONTOUR SAWING AND FILING MACHINES

HOW TO REDUCE YOUR CUTTING TOOL COSTS

Three elements are absolutely necessary if there is to be a substantial reduction in cutting tool costs—the right tool, the right geometry of grind on that tool, and the right machine to produce the grind. There are various machines which will always be most suitable for specific applications. However, for the average cutter grinder jobs, Oliver has pioneered a new approach to the problem with the introduction of the "ACE" tool and cutter grinder.

The cost savings are attractive with respect to both setup time and grinding time. Setup usually consists of two simple "direct-reading" adjustments. The first setting is made to produce the angular or straight line grind requirement. The second setting consists of tilting the grinding wheel spindle to produce the proper clearance—all extremely simple.



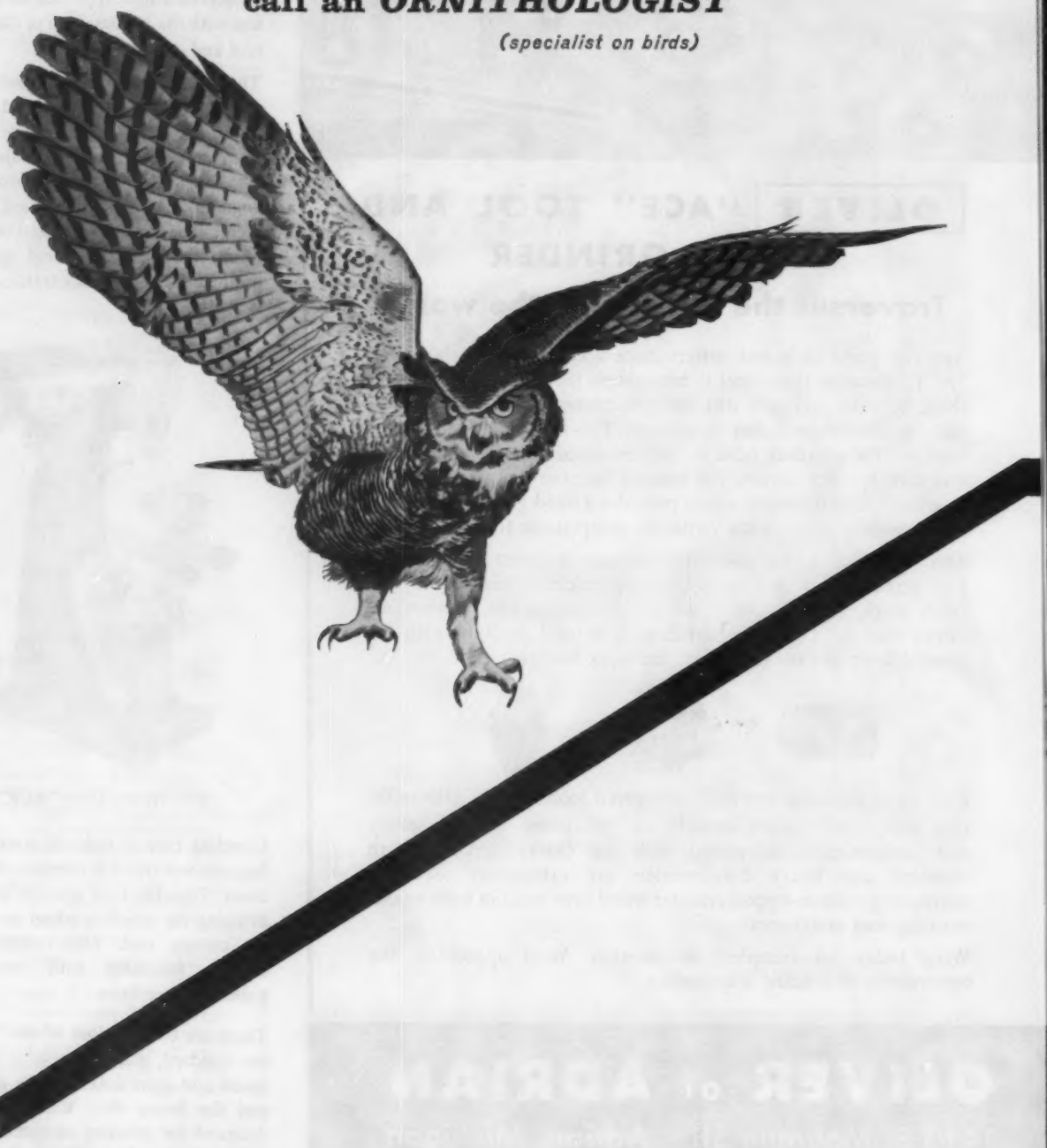
The Heavy Duty "ACE"

Grinding time is reduced considerably because tool travel is eliminated in most cases. Thus the time consists wholly of bringing the grinding wheel on and off the cutting tool. This compares extremely favorably with competitive grinding procedures.

There are two versions of the "ACE": the standard, which is suitable for high speed and light duty carbide grinding, and the heavy duty model which is designed for grinding tungsten carbide cutters and tools in all of their many forms.

For tips on finding the Great Horned Owl...
call an *ORNITHOLOGIST*

(specialist on birds)



for tips on welding stop-and-go jobs... call in *LINCOLN*

(specialists in arc welding)

A KANSAS MANUFACTURER OF MOBILE HOMES doubled the welding speed on his undercarriages by simply changing electrodes—and in addition, saved over $8000 in the first year.

Manufacturing cost on undercarriage fabrication was prohibitive. Thirteen gauge cross members were welded to twelve gauge channels by welds made in both vertical and flat positions. These short welds on steel having some scale and oil slowed down production.

Finally they called in their LINCOLN Field Engineer. Painstaking tests, made by the LINCOLN man with the welding foreman and plant superintendent, proved LINCOLN's Fleetweld 37 electrodes far better for this application.

RESULTS: lower costs . . . welding speed doubled . . . cleaning time cut in half.

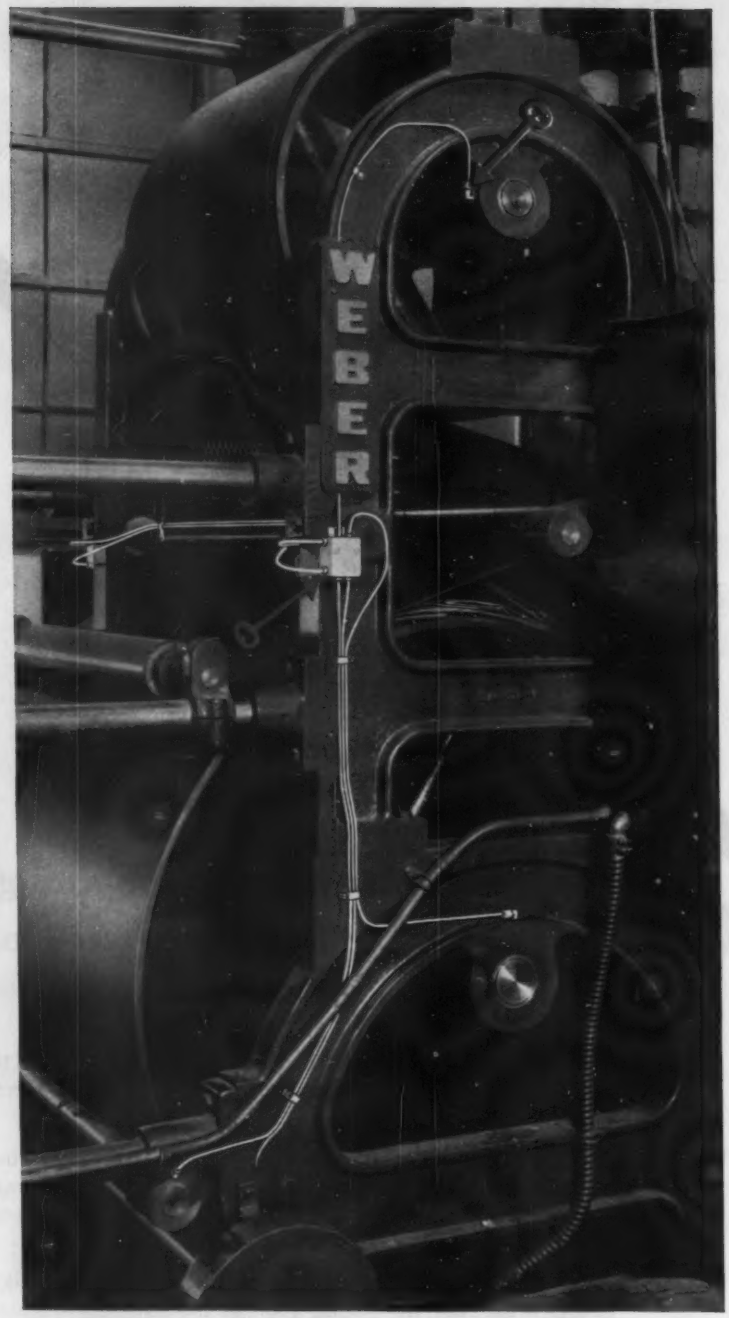
That's why we say it's a good idea to do business with LINCOLN where arc welding is a specialty and cost reduction comes to you as a "plus" at no charge.

THE LINCOLN ELECTRIC COMPANY
Dept. 2240 • Cleveland 17, Ohio

LINCOLN WELDERS

For more data circle this page number on card at back of book

Farval eliminates downtime, saves lubricant on Weber high-speed bag machine



FARVAL—Studies in Centralized Lubrication No. 219

THIS Weber Bag Making Machine at Bemis Bro. Bag Company's Vancouver, Washington, plant has been in continuous trouble-free operation for over 3 years. Its modern Farval system—continuously delivering measured amounts of lubrication at regular intervals—has eliminated all downtime due to either faulty lubrication or bearing loss.

Bemis Bro. Bag report their Farval system saves over 20% in lubricant required as well as contributing to the over-all cleanliness of the general work area. This is most important in the paper bag industry, because a dirty, stained product means rejects—lower profits.

Investigate how a Farval system can solve your lubrication problems. Write today for Revised Bulletin 26-T.

Farval Division
Eaton Manufacturing Company
3276 East 80th Street
Cleveland 4, Ohio

KEYS TO ADEQUATE LUBRICATION

Wherever you see the sign of Farval—familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated.

PRECISION MEASURING TOOLS — No. 445C-3RL Micrometer Depth Gage with full base, No. 443-3RL Micrometer Depth Gage with half base illustrated above

accuracy comes easier with Starrett® tools

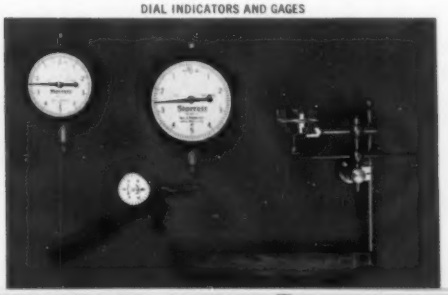
Skill works unhampered when Starrett tools are close at hand. For example, craftsmen who use a full base micrometer depth gage for depth measuring in the clear can reach for the new half-base model to get the same sure accuracy in confined places. Both have SATIN-CHROME Finish — the no-glare, corrosion defying hard chrome finish pioneered by Starrett.

Your nearby Industrial Supply Distributor can supply more than 3,500 fine Starrett products — all made to speed and simplify precision work. Write for complete catalog No. 27. Address Dept. D, The L. S. Starrett Company, Athol, Massachusetts, U. S. A. . . .

World's Greatest Toolmakers

PRECISION GROUND DIE AND FLAT STOCK

DIAL INDICATORS AND GAGES

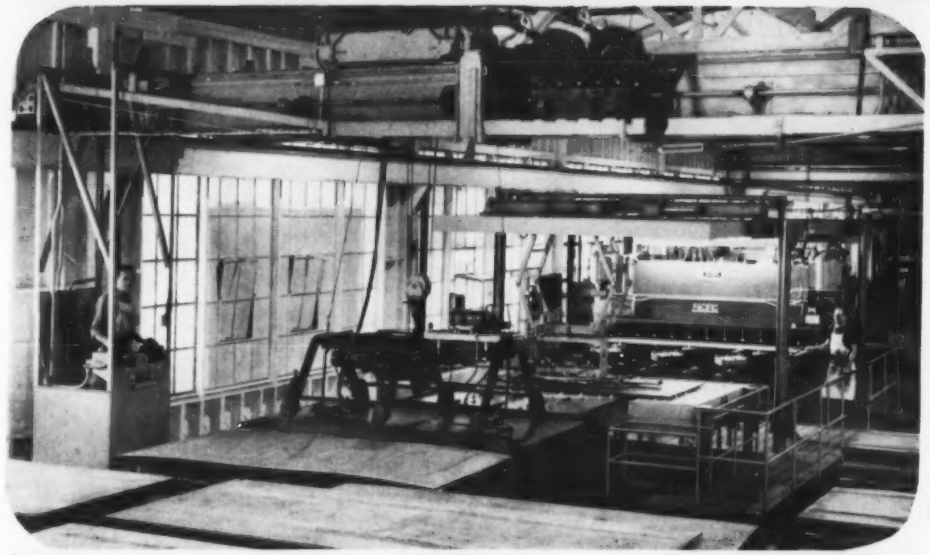


HACKSAWS, HOLE SAWS, BAND SAWS, BAND KNIVES

CUT CONTROL ENABLES PACIFIC HYDRAULIC SHEAR TO DO JOBS IMPOSSIBLE ON ANY OTHER SHEAR!

PACIFIC *Cut Control* is a group of adjustments permitting all controls to be set at the optimum value for perfect shearing of each different job: light gauge, heavy plate, polished stainless, soft aluminum, brittle alloys, long narrow strips, high speed cycling for high production, extreme accuracy for precision work. Unlike conventional shears limited in shearing ability by permanent settings without possible adjustment, PACIFIC can be controlled to fit the job exactly. No longer is it necessary to compromise with quality because the shear cannot be adjusted.

- **Adjustable holddowns** eliminate marking of soft polished sheets.
- **Holddowns move down independently of knife** to insure exact alignment of plate before cutting.
- **Adjustable knife clearance** for light gauge shearing with heavy plate shear. Eliminates rough secondary shear fracture in heavy shearing.
- **Rake angle adjustment** for minimum twist or bow in cutting narrow strips.
- **Cushioned shearing** plus rake angle adjustment enable brittle alloys to be cut.
- **Depth of stroke** readily adjustable for slitting.
- **Adjustable cycling speed** so machine speed can be set to match operator's ability to feed plate.
- **Non-wedging back gauge lift** to prevent wedging of narrow strips being cut.
- **Rapid, precision powered back gauges.**



Triples output by automating PACIFIC shear... saves 3 men, 2 shears!

Food Machinery & Chemical Corp., Riverside, Calif., reduces a 3 shear, 5 man operation to a 1 shear, 2 man operation by developing an automated sheet and plate handling system to match the high cycling speed of the PACIFIC hydraulic shear. System consists of vacuum handlers on overhead cranes, accumulator conveyor, hinged ball transfers, powered scrap chute behind shear, return conveyor under shear, table to elevate and rotate pieces for additional cutting. Shockless hydraulic cutting permits mounting shear on I beams above return conveyor for simplified materials handling.

Heavy duty shear for continuous mill type service

Safe—the only shear that can be stopped instantly in emergency and is protected against overload

3 to 8 times longer knife life than mechanical shears

Noiseless operation—quieter than a sewing machine

Insignificant maintenance—all moving parts run in filtered oil and are protected against overload

Hundreds of dollars saved in foundation cost

Proven design—over 100 PACIFIC Shears in operation up to 5 years.

PACIFIC PRESSES AND SHEARS

PACIFIC INDUSTRIAL MFG. CO., OAKLAND, CALIF. • PACIFIC PRESS AND SHEAR CORP., MT. CARMEL, ILL.

DISTRIBUTORS: ALBUQUERQUE, N. M.; DENVER, COLO.—R. E. Dubac Associates • ARIZONA; LOS ANGELES AND BURLINGAME, CALIF.; NEVADA—Tornquist Machinery Company • ATLANTA GA.; ORLANDO, FLA.—J. R. Carlson Machinery Company • CHICAGO (North), Ill.—L. C. Evans & Company • CHICAGO (South), Ill.—B F M Machinery Co. • CLEVELAND, OHIO—Jackson Machinery DAVENPORT and DES MOINES, IOWA; KANSAS CITY and ST. LOUIS, MO.; OKLAHOMA—Moehlenpah Engr. Inc. • DETROIT, MICH.—Taylor Thompson Machinery Company • DALLAS, TEXAS—Machine Tool Associates • HAMILTON, OHIO—Anscheutz Machinery • HOUSTON, TEXAS—Butcher-Carter-Preston • INDIANAPOLIS, IND.; LOUISVILLE, KY.—H. B. Green Mch. Co. • NEW YORK CITY—Van Dyke-Churchill Co. • MILWAUKEE, WIS.; MINNEAPOLIS, MINN.—Gute Company • NORFOLK, VA.; KNOXSVILLE, TENN.—Tidewater Supply Co. • NEW ORLEANS, LA.—Dixie Mill Supply Co. PITTSBURGH, PA.—Howard Canning • PORTLAND, ORE.—Portland Machinery Company • ROCHESTER, N.Y.—Ogden R. Adams Co., Inc. • SALT LAKE CITY, UTAH—Todd Machinery Company • SEATTLE, WASH.—Portland Machinery Co. • EASTERN PENNSYLVANIA; WASHINGTON, D.C.; MARYLAND; DELAWARE; SOUTHERN NEW JERSEY—Edward A. Lynch Machinery Co. • WETHERSFIELD, CONN.—Beisel Machinery Company • TORONTO, ONT., CANADA—Hercules Presses Ltd. • WINNIPEG, MAN., CANADA—Taylor Machinery Company • HALIFAX, N. S.—Foullis Eng.

Precision Spherical Milling

When one of the leading bearing manufacturers introduced its new spherical roller bearings, milling the centrifugally cast bronze retainers for these "barrel-shaped" rollers presented problems of both machine and tool design.

Especially designed GREENFIELD carbide tipped end mills are milling this complex form in sizes .496" to 1.721" to precision tolerances and finish.

Let GREENFIELD work with YOUR machine tool builder where special engineering service is required.

Quality MACHINES + Quality TOOLS = Quality PRODUCT

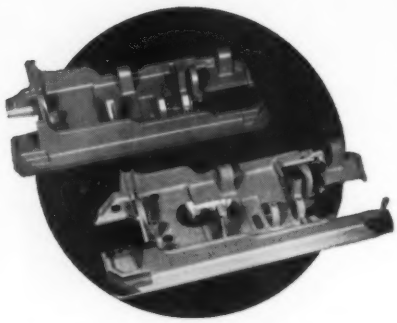
GREENFIELD TAP & DIE
GREENFIELD, MASSACHUSETTS

Sub-contracting precision parts, assemblies and machines like these... is our business!

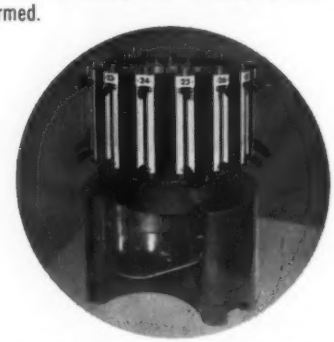
(but we want more of it)

We'd also like to prove to you what our completely integrated manufacturing facilities* can mean to you in terms of lower costs, faster delivery, and complete satisfaction.

TMW's facilities and 65 years' experience in high-precision (tolerances to tenths) manufacturing are available to you *now*, on a short or long-term basis. For details or a new Facilities File Folder, call or write today.



A TMW gray iron casting before and after precise machining, annealing and finishing operations were performed.



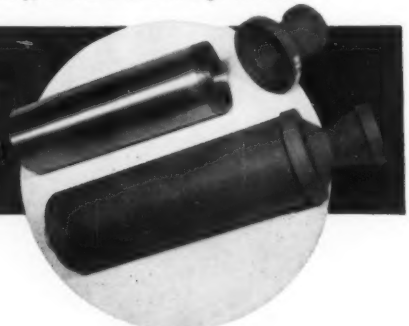
Paint dispenser was economically mass produced for a major manufacturer in TMW's modern shops.

"The world's first and only automatic stud fastener" . . . (another example of TMW precision machining and assembly) carries a LIFETIME guarantee.

* Includes 1,000,000 sq. ft. of manufacturing space, 1200 *modern* machine tools, completely mechanized foundry (one of the world's largest), 3000 skilled craftsmen with a corps of top designers and engineers.

TEXTILE MACHINE WORKS

Contract Division • Reading, Pennsylvania



Jato units, used on the "Honest John" rocket to make it spin, are machined to ±.0002" tolerances and hydrostatically tested to meet strict government specifications.

"OUR CENTRAL ENGINEERING STAFF SPEARHEADS A CONTINUOUS REVIEW OF NEW DEVELOPMENTS"...

William J. Wiley

Vice President in charge of Finance and Treasurer

SKF® *Industries, Inc.*

"SKF Industries, Inc., manufactures various types of anti-friction bearings including miniature, ball, spherical roller, cylindrical roller and tapered roller bearings. The sizes in our broad product line range from 3/16-inch outside diameter to over four feet. Consistently high quality and extremely close tolerances are a precision must in all SKF bearings.

"Our equipment must perform at peak efficiency to maintain demanding tolerances and quality standards. To assure this, the SKF Quality Control System requires a sample test be made after each machine operation. Should any deviation from quality standards be detected, the equipment is shut down until the problem is corrected. And when the cause is due to faulty equipment, an investigation is launched to see if the equipment must be repaired or replaced.

"The search for new methods and equipment to economically raise quality and efficient work levels is a constant one at SKF. Our central engineering staff spearheads a continuous review of new developments in industrial equipment to keep all SKF divisions posted on those applying to our industry.

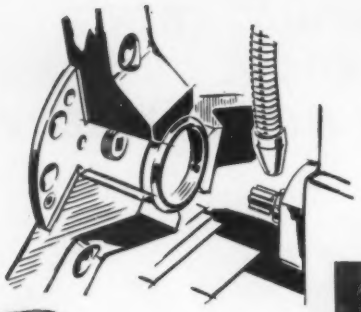
"Proposals and suggestions co .ing from every section and division of the company are appraised to establish their economic merit. Approved proposals must provide returns exceeding the established cut-off rate.

"The most important factor in SKF's decision to buy is getting maximum return."

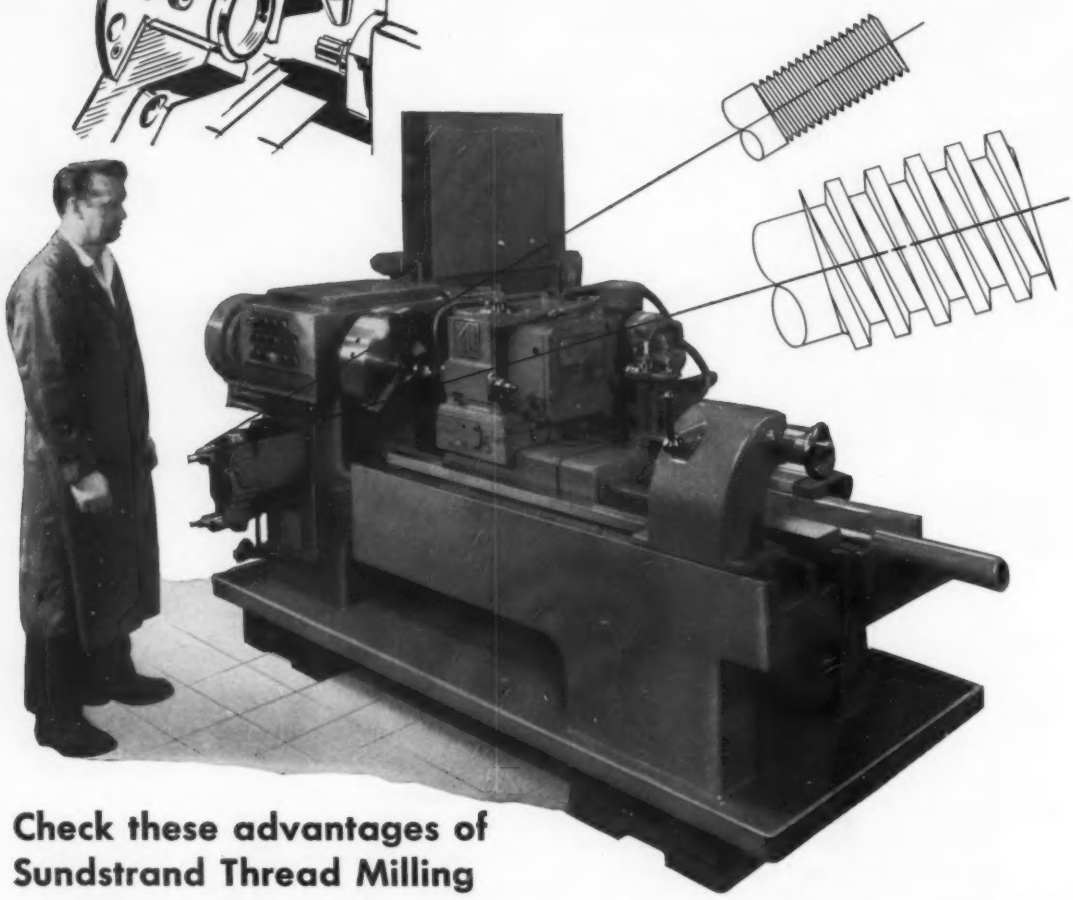
Rockford Insert Group...

Keep gathering metal working production ideas . . . be well informed when you replace machinery . . .

New Sundstrand Machine

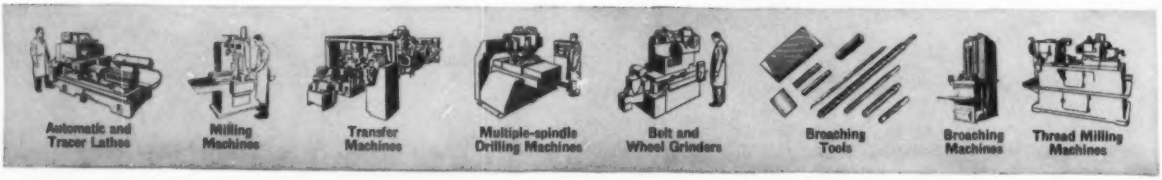


The cutter rotates as it feeds full thread depth into the rotating workpiece. While the workpiece makes one revolution, the cutter is moved lengthwise the exact amount of lead required.



Check these advantages of Sundstrand Thread Milling

- Mills internal or external threads . . . right or left hand . . . straight, tapered or special . . . with any lead up to ½".
- Produces internal or external threads on interrupted work surfaces, such as splines, key slots and flutes.
- Machines thread pitches too coarse to be practical for die or tap cutting.
- Produces faster at lower cost than single-point tools, disc cutters, grinding wheels, or previous thread milling machines.
- Makes external threads one pitch away from a shoulder, internal threads one pitch from the bottom of a blind hole.
- Accurately relates pitch diameters to other elements of the workpiece.
- Mills threaded and plain diameters simultaneously.
- Simultaneously mills two threads of the same pitch and lead on the same or different diameters.
- Threads workpieces of various diameters with a single cutter.



CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

Simplifies Thread Milling

features sine bar adjustment for threads up to ½" lead, fully automatic cycling, and five minute change-over.

The new Sundstrand Universal Automatic Thread Milling Machine speeds production, insures accuracy, and minimizes scrap loss on a wide range of threading operations, including those difficult, costly, or impractical by any other method.

The machine employs multiple thread cutters having no lead but with the desired pitch and thread form. The new and exclusive sine bar mechanism is dial-adjustable to provide an infinite range of thread leads of 0 to ½".

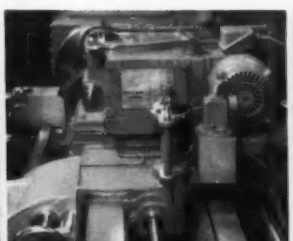
Because there are no gears or cams to change for different thread leads, change-over to a new part is fast and easy. Setup can be completed in about five minutes after the cutter and part are placed in position, making the machine ideal for short or long runs on a wide variety of parts.

No special operator skills are required to consistently mill high-quality uniform threads — the machine easily produces to the exacting requirements of military and aircraft specifications.

Four models are available to handle workpiece lengths up to 24", 48", 72", and 96". Various optional accessories include: Taper cutting attachment to mill any thread taper up to .100" per lead; automatic or manual facing attachment for turning shoulders and faces square with the thread pitch diameter; power positioning unit which moves the cutter head longitudinally to speed setup when handling a variety of part lengths; tailstock for external work; steady rest for 1" to 6" diameter parts.

For complete information and specifications, write for new Bulletin 620.

SINE BAR DIAL ADJUSTMENT, graduated in increments of .0002", provides any lead up to ½", including specials.



DIAL-ADJUSTED CUTTER HEAD. The cutter head is easily positioned and clamped longitudinally on the ways and transversely across the ways by dial adjustment.

INFINITELY VARIABLE FEED. During setup and automatic cycle, the feed is infinitely variable from 1.15 rpm to 6 rpm by adjustment of the feed control.

ADJUSTABLE CROSS TRAVEL. Total cutter head cross travel of 1-3/8" (including 3/8" max. feed) can be easily adjusted to the proper setting for any part.

SUNDSTRAND

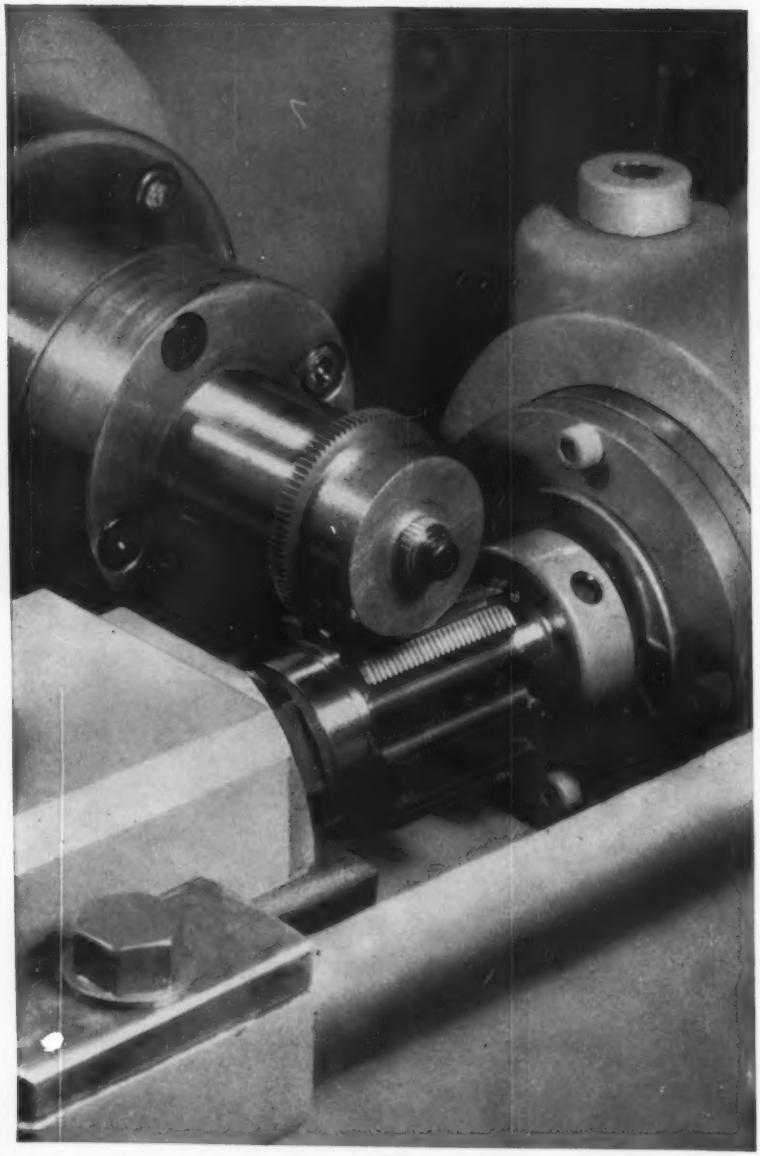
SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS • DIVISION OF SUNDSTRAND CORPORATION

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

New method of producing

AGMA Precision



Selection and segregation no longer necessary to insure precision-matched spur gear sets

Selection and segregation — the process of producing more gears than you need in order to select a few that are within Precision Class 2 or Class 3 tolerances — is no longer necessary. And, these jobs at PIC Design Corporation, East Rockaway, L.I., New York, prove it.

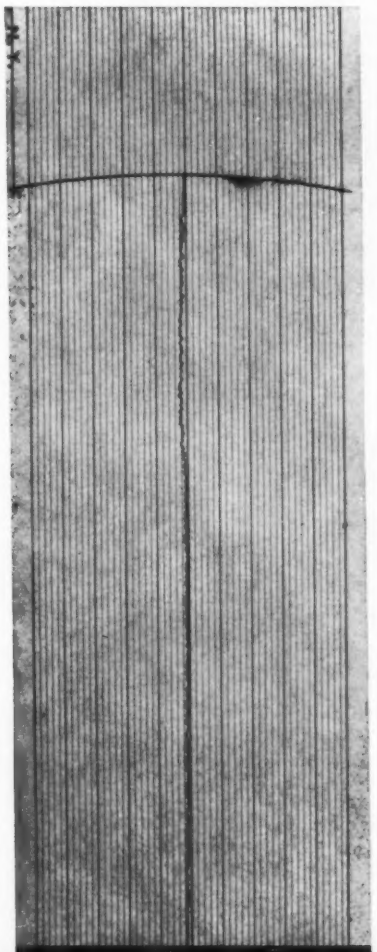
In pioneering "Ultracision" accuracy for the missiles industry, Barber-Colman Company developed extensive machining and testing techniques now embodied in a new, low-cost hobbing machine—the No. 2½-4. For mass production of easily machinable parts which do not require such a high degree of accuracy, a high-speed version of this machine is available with a maximum hob speed of 2400 rpm.

Completely new hobbing machine

New concepts have been introduced into the Barber-Colman No. 2½-4 to bring you exceptional accuracy at a nominal cost. The No. 2½-4 is guaranteed to index accurately within 20 seconds of arc. This means that nonadjacent spacing error on a 2" dia. gear would be only .0001" due solely to the indexing error of the machine. When rigid tooling . . . accurate blanks . . . care in mounting the hob and work . . . Class AA hobs . . . and accurate hob-sharpening methods are used, it should be possible to hob AGMA Precision Class 2 and Class 3 gears without selection and segregation. Scrap and inspection time are reduced. And, in many

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

Class 3 Gears



Each line on tape represents .0001". This Precision Class 3 gear was obtained with only slightly more care than required for Class 2 gears.

cases, deeper savings can result from the elimination of finishing operations.

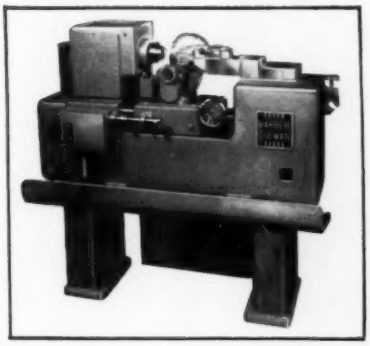
The accompanying PIC "true blue" gear tape shows the inspection record of a Precision Class 3 gear. On the production run, all gears had a total composite error of less than .0004". The gears have 96 teeth of 64 DP. The tape is made on a variable center-distance checking machine with a motor-driven master gear which rolls under preset pressure with the cut gear. After the work spindle adapter and the hob were trued within .0001", no further adjustments were necessary for hobbing gears of this accuracy.

The No. 2½-4 accommodates 3" dia. hobs, permitting maximum number of flutes for cutting accurate, smooth tooth profiles. Maximum work diameter is 2½" and length of cut is 2¼" — for steel gears as coarse as 30 pitch or brass up to 20 pitch.

PIC pursues accuracy in every corner of production

As you examine the results being achieved with the No. 2½-4 by PIC Design Corporation, you will see that in their pursuit of predictability and precision, no stone is left unturned.

Bores of Precision Class 2 and 3 gear blanks are machined to +.0002", -.0000" for size and roundness. Before turning, blanks are mounted on arbors the same size as the bores, with a .0002" taper. They are inspected for face wobble and must run true within .0002" per inch of diameter before the OD's are turned to a concentricity tolerance of .0001". This operation is checked at two points, 180 deg. apart.



In hobbing, the arbors are held in a floating adapter which permits fine adjustment to desired concentricity. PIC uses only Barber-Colman Class A or AA hobs, trued on the machine to less than .0001" runout.

Evaluate your gear processing and costs

If you have the problem of producing precision fine-pitch gears at a profit or want to improve your product by increasing gear accuracy, a Barber-Colman process analyst will help you evaluate methods, tooling, and cost improvements. Phone your B-C representative or the factory — WO 8-6833.

Barber-Colman Company

BARBER COLMAN

102 Loomis Street, Rockford, Illinois

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

FINISH-MACHINES VALVE SEAT and STEM HOLES in Single Pass

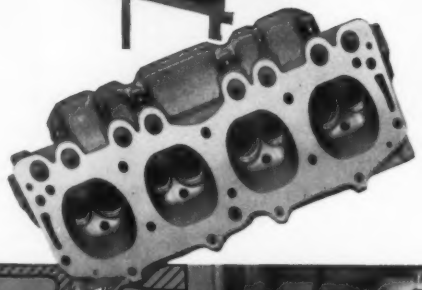
BARNES 2-STATION PROGRESS-THRU VALVE FINISHING MACHINE. Handles two different width V-8 cylinder heads. Finish faces and bores two exhaust and two intake valve seats and stem holes at each working station. An interchangeable guide rail is used for smaller head, .110" narrower in width. Gross production rate is 123 pieces per hour.

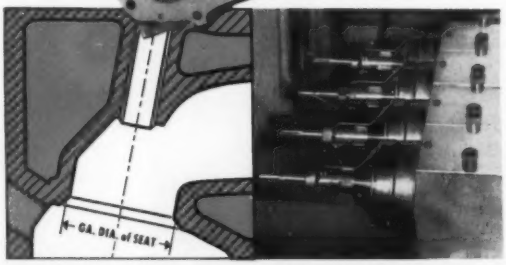
Exclusive W. F. & JOHN BARNES Development Eliminates Reaming, Cuts Finishing Cost

More and more manufacturers of internal combustion engines are today profitably using W. F. and John Barnes machines to cut costs in processing valve seats and stem holes. The accuracy of this new, exclusive tooling method reduces machining costs by eliminating the need for reaming or other final finishing operations. Guide holes are finish-bored and valve seats finish-faced simultaneously in a single pass. Concentricity of the valve stem hole and face is held within .0005" total indicator reading.

Basic Method Can Be Easily Applied To Either Small or Large Jobs

The efficiency of this new machining method can now be economically applied to all types of valve jobs — small as well as large cylinder heads or blocks. Either fully automatic or semi-automatic machines can be provided to suit your production needs. As illustrated, single machines can also be designed to efficiently handle more than one size workpiece which effects additional savings in floor space and equipment costs.





CONCENTRICITY .0005" T.I.R.
Fine finish to precision tolerances eliminates reaming operations. Concentricity of guide hole and gauge diameter of seat is held to .0005" T.I.R.

DUAL-TYPE PRECISION SPINDLES
Dual-type precision spindles equipped with facing and gun boring tools. A second 4-spindle head on machine above completes valve operations on V-8 cylinder heads.

Builders of Better Machines Since 1872

W. F. & JOHN BARNES

ASK FOR AN ANALYSIS OF YOUR MACHINING METHODS — Ask a Barnes engineer to work with you when planning new or improved machining methods. His experience with, and knowledge of, proven cost-cutting methods can help you save time and money. *Write for New Catalog* illustrating how Barnes 6-point machine building service saves you time, and eliminates divided responsibility.

W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

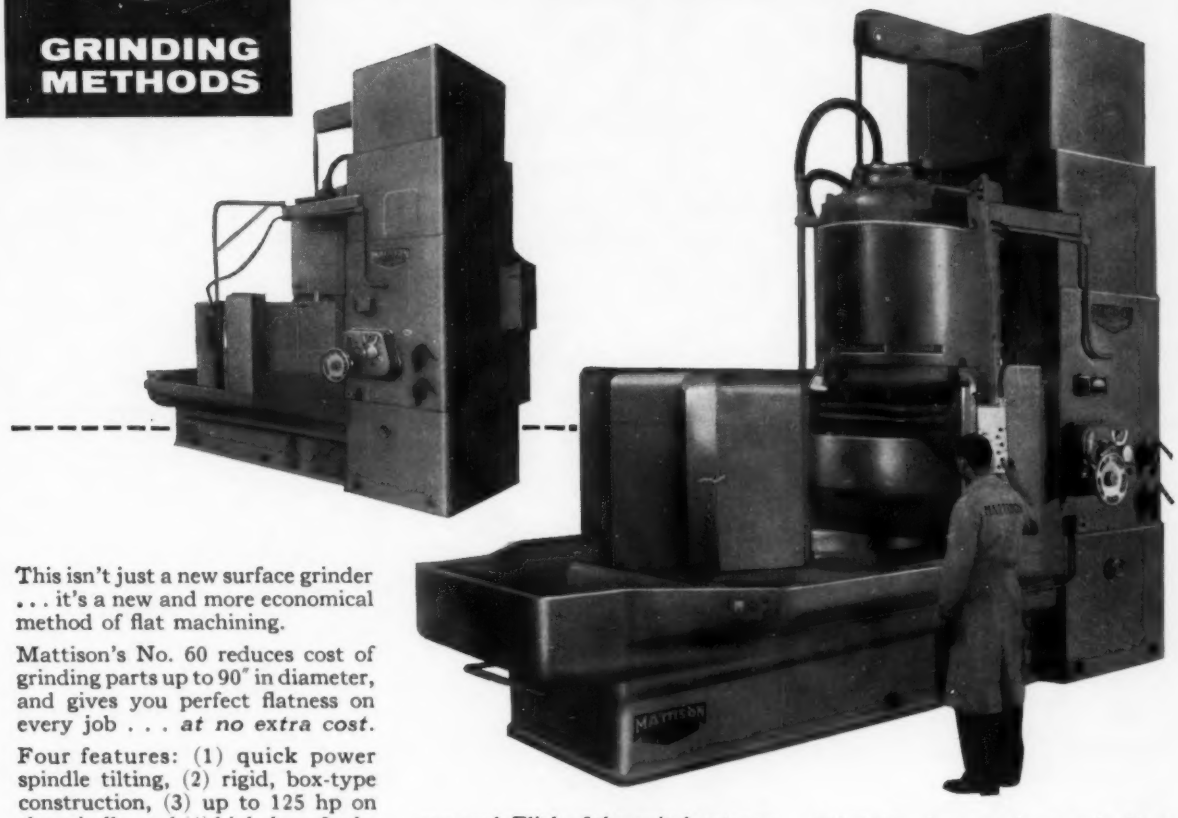
Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress Thru Transfer-Type Machines

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

MATTISON
HIGH-POWERED PRECISION

GRINDING METHODS

Grinds 90-inch diameter work 50% faster to close limits



This isn't just a new surface grinder . . . it's a new and more economical method of flat machining.

Mattison's No. 60 reduces cost of grinding parts up to 90″ in diameter, and gives you perfect flatness on every job . . . *at no extra cost.*

Four features: (1) quick power spindle tilting, (2) rigid, box-type construction, (3) up to 125 hp on the spindle, and (4) high downfeeds, put this precision surface grinder in a class with cutter-type machining for stock removal. In fact, they make it 50% more productive than conventional grinding, without sacrificing accuracy or finish.

Think of the economies on jobs you may now be milling, planing, or shaping. Faster loading and unloading on magnetic chucks reduces downtime costs. You have no fixture costs. There is almost no downtime for servicing the wheel—tool changing, tool sharpening, and tool setting costs are eliminated.

Quick-Tilt combines rough and finish grinding

Now you can combine maximum stock removal and "finish" accuracy in one operation. With quick *power* spindle tilting, you take advantage of today's improved wheels. You rough out the workpiece, grinding on the wheel's leading edge. Fewer grains in contact with the work permit a "hard" cut to boost stock removal. Flick of the switch returns spindle to vertical position for a fast finishing cut.

High horsepower keeps wheels self-dressing

The No. 60 uses up to 125 hp to keep 32-inch wheels self-dressing as they hog off stock. When roughing, you get positive grain penetration and high stock removal at high downfeeds. Tough wheels remain free-cutting, grinding for flatness and finish. You avoid finish and wheel-life headaches caused by heat.

Continuous downfeed increases accuracy

Downfeed is continuous from .005″ to .165″ per minute. When you reach size, feed stops instantly—not one increment away. You can split the last increment of a ratchet-type feed to meet close limits. Predetermined stops (.001″ to .240″) let you set the feed and grind to size without miking.

Rigidity key to fast grinding

Mattison's box-type, one-piece column is bolted and keyed to the base. Dense Meehanite metal deadens vibration, resists wear, and provides the rigidity necessary to meet close tolerances. Only this equivalent of a one-piece "L"-shaped casting gives you a machine that stays put under a real hogging cut and leaves minimum stock for spark-out.

Free methods study

Is this new method of flat machining economical for your production? Send us your pieceparts for a sample grind in the Mattison Methods Laboratory. Your Mattison dealer will make all arrangements—or, phone the factory direct.

MATTISON MACHINE WORKS

Rockford, Illinois Phone WOodland 2-5521

MATTISON MACHINE WORKS

HIGH-POWERED PRECISION SURFACE GRINDERS

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

MACHINES DESIGNED WITH THE FUTURE IN MIND

PRODUCTION MACHINERY
GREENLEE

- Special Purpose Machines
- Transfer-Type Processing Machines
- Multiple-Spindle Drilling and Tapping Machines
- Six and Four-Spindle Automatic Bar Machines
- Die Casting Machines
- Trim Presses
- Woodworking Machines and Tools
- Hydraulic and Hand Tools

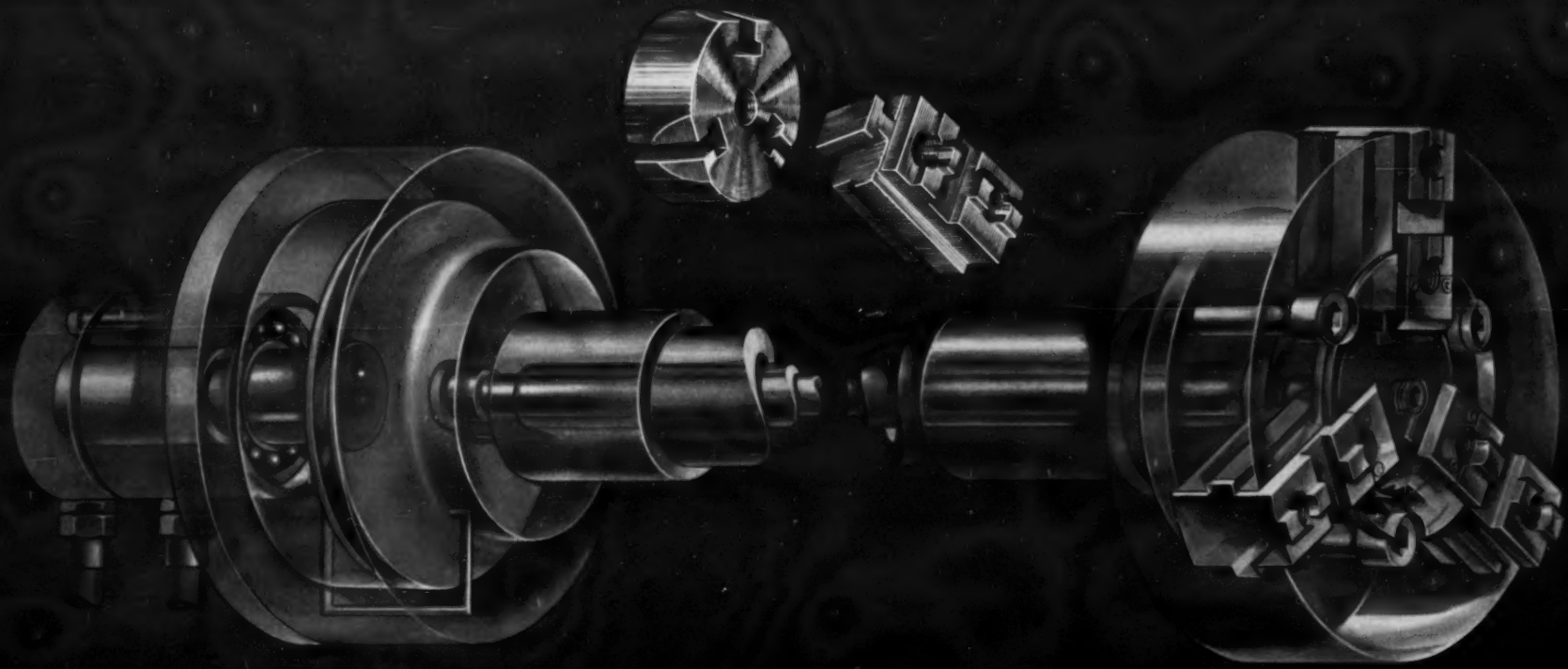
COOPERATIVE TEAMWORK MAKES THE DIFFERENCE

Through every phase of the construction of a Greenlee transfer machine, Greenlee engineers maintain a close contact with you, the customer. They are strong on the buyer's viewpoint . . . know what cost-conscious management wants. They stay on the job from the time of initial planning until your machine is operating at full efficiency. This last phase—the proving out period—is especially important. Greenlee men are extremely helpful in bringing your machine up to full production . . . training your operators to keep it producing profitably Call Greenlee. Let them show you how cooperative teamwork can benefit you.

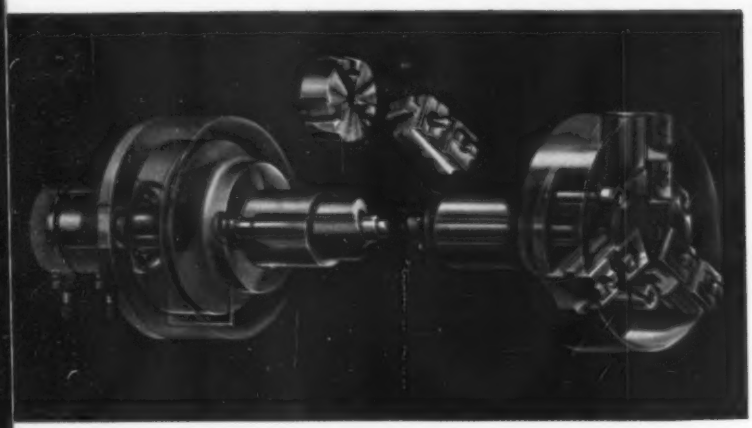
GREENLEE BROS. & CO. 1943 MASON AVE. ROCKFORD, ILLINOIS

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

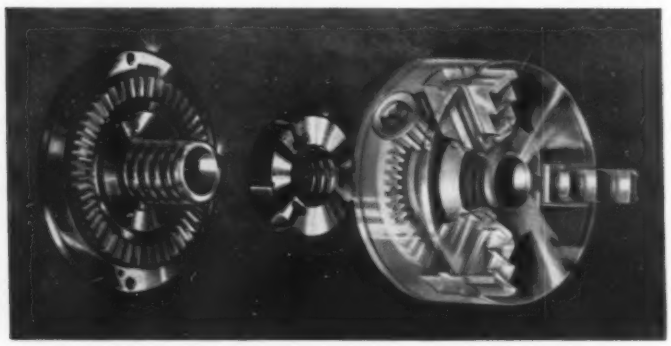
SKINNER PACKAGED POWER CHUCKING ASSEMBLY



Typical major chuck developments that come to you from SKINNER



Packaged power chucking assemblies are available for Atlas, Cintilathe, Hardinge, Logan, Regal, Sheldon, South Bend, and many similar lathes. Assemblies are also available for Brown & Sharpe and similar automatic and hand screw machines to permit chucking of cold drawn parts, small or odd shapes and castings. Packaged assemblies consist of chuck with two or three jaws, threaded drawbar and drawtube, rotating air cylinder, cylinder adaptor and necessary mounting for the individual machine.



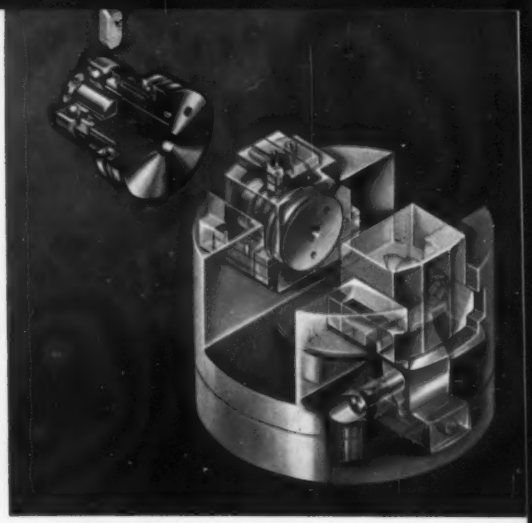
Extra-heavy-duty Wedge-Screw chuck combines best features of power and hand chucks. It develops tremendous gripping power, high accuracy and repeatability by a unique principle. When the lug-type pinion is turned manually or by a power wrench, it engages the gear plate causing the screw to move the wedge. The force of the wedge on the jaws holds the work with tremendous power.

This Wedge-Screw chuck has such useful features as:

Accuracy—within .001 total indicator reading
Repeatability—within .0005 total indicator reading
Complete Range—no size limitation

Many other features including over-tightening and operator protection, sealed operating mechanism, automatic lubrication, etc.

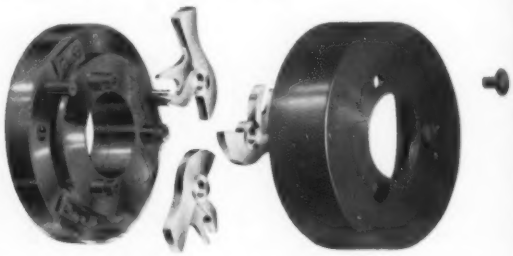
For complete details about packaged power chucking assemblies, indexing chucks, wedge-screw chucks, +GF+ Work Drivers, other chucks and chuck equipment, contact your Skinner Representative or Distributor, or write us at the address below.



Heavy-duty power chuck with jaws that index freely under full pressure. Indexing is simple, easy, and fast. The operator can index manually without touching the work or releasing the pressure. Jaws are indexed by means of a lock screw and slide plate. Note the size and shape of the indexing pin. It fits firmly and positively into the indexing plate so that extreme accuracy of indexing is assured.

One or both jaws can be furnished with indexing mechanisms. As a result, you can index more positions and smaller index angles. There is no need to buy a new chuck for different indexing positions because index jaws or index components can be interchanged quickly and easily.

This new Skinner chuck is available in all body diameters from 12″ through 36″.



+GF+ Work Drivers distributed by Skinner, are the best clamping devices available for driving rough or smooth blanks between centers. Eccentric jaws with floating spring action hold firm, and any increase in cutting tool pressure and/or spindle speed automatically increases the holding power of the work driver. The jaws are easily reversed to accommodate changed direction of spindle rotation.

The protective hood covers all mechanism and provides means of manually opening and closing jaws. A slight turn of the hood, with surface cross-hatched for sure grip, opens jaws and holds them open until work is placed between centers—another turn releases jaws to grip work. **+GF+** Work Drivers are available to hold work ranging in diameter from $1\frac{1}{32}$″ to $8\frac{1}{16}$″.

Maximum eccentricity of any piece is $\frac{5}{32}$″. Finished adaptor plates or rough castings are available for mounting on all types of machines.

See these Skinner products at the Production Engineering Show Booths 212 & 214.

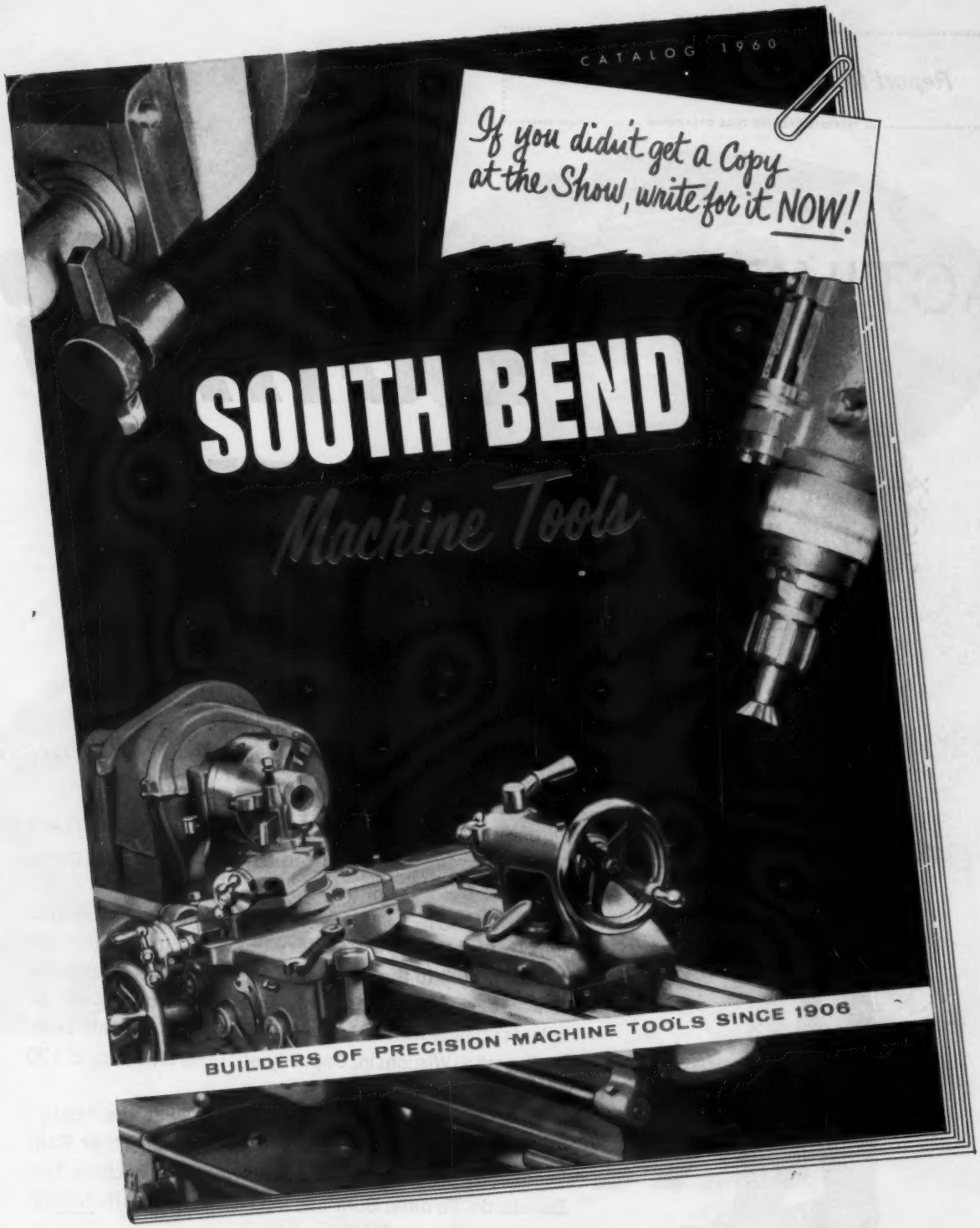
SKINNER CHUCKS®

THE CREST OF QUALITY

SKINNERCHUCKS

THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT, U. S. A.

PRINTED IN U.S.A.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If you didn't get a Copy at the Show, write for it NOW!
SOUTH BEND
Machine Tools
BUILDERS OF PRECISION MACHINE TOOLS SINCE 1906

NEW 96-page catalog of South Bend machine tools and accessories

SOUTH BEND LATHE, INC. • South Bend 22, Indiana

For more data circle this page number on card at back of book

Report to the **SMTS*** *Committee*

*SPECIAL MACHINE TOOL STANDARDS

ACTIVATION: BUHR'S "BABY"

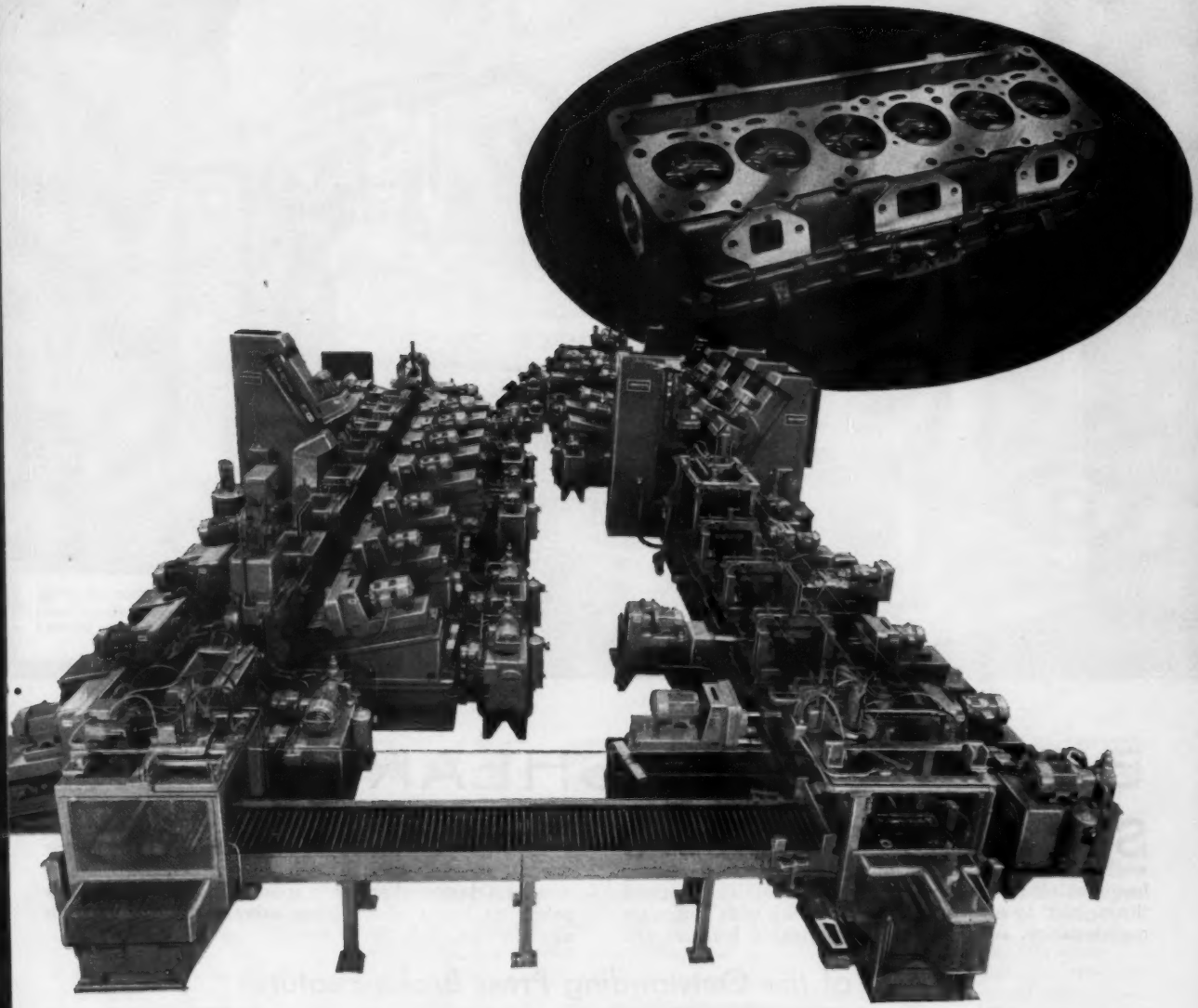
walks alone.....

Already assembled, tooled and running test parts! That's the latest word from American Motors Corporation, owner of Buhr's Baby.

The "Baby," as nearly everyone knows, is a lift-and-carry, part-through transfer—the first major transfer machine built to the new Special Machine Tool Standards. It was designed to perform 323 precision operations on cylinder heads for 1961 Rambler engines at the AMC plant in Kenosha, Wisconsin. Capacity at 100% efficiency is 120 pieces per hour.

And we are proud to announce that while the "Baby" was under construction, we started work on other Buhr Economatics to be built to the new Special Machine Tool Standards. To date, Buhr has built or is building its twenty-eighth additional "SMTS" machine.

BUHR MACHINE TOOL COMPANY • ANN ARBOR,



BUHR

(say BURE)

ECONOMATIC®

MICHIGAN

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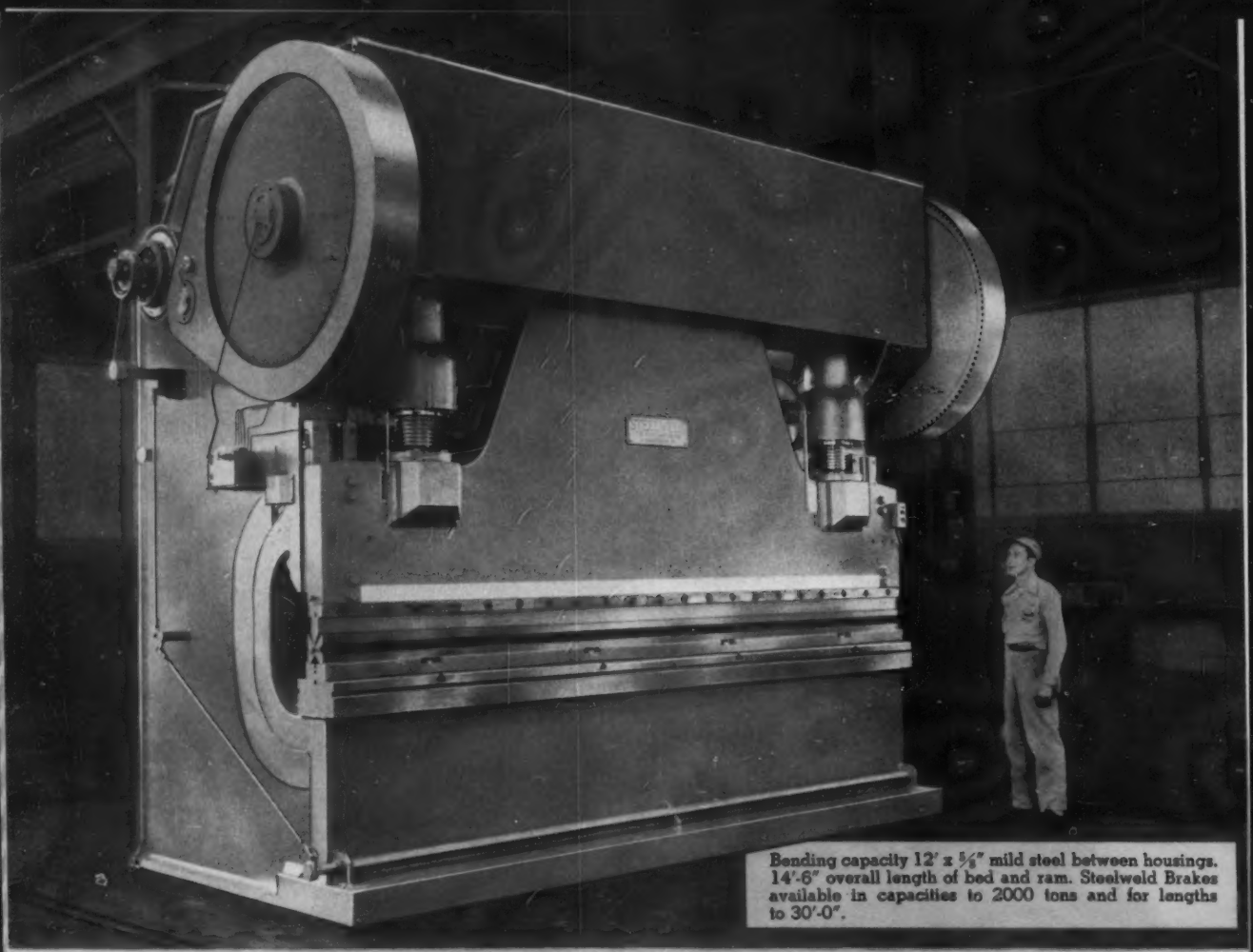


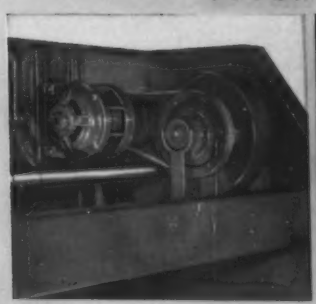
Bending capacity 12' x 5/8" mild steel between housings. 14'-6" overall length of bed and ram. Steelweld Brakes available in capacities to 2000 tons and for lengths to 30'-0".

BRAKES and SHEARS BUILT

STEELWELD machines are built to withstand the rigors of mass-production high-speed work, as well as meet the needs of jobbing shops requiring frequent set-up changes. They are liberally designed throughout to assure maximum service with minimum maintenance. A wide array of desirable features are provided, some of which are not available elsewhere.

Steelweld Brakes and Shears are easily adapted for special requirements. Our engineers will be glad to work out design changes to speed production, improve safety or bring about other advantages for specific applications.

A Few of the Outstanding Press Brake Features



SW-309

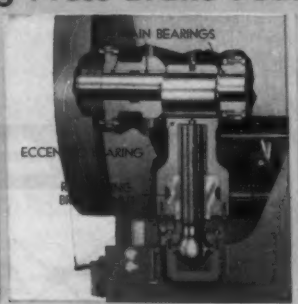
Long Life Clutch and Brake

Heavy construction assures long trouble-free life. Facings are extra heavy and plates solid. Cool air constantly flows across plates. Adjustments easily made without tools.

SW-488

Slides Compensate For Wear Automatically

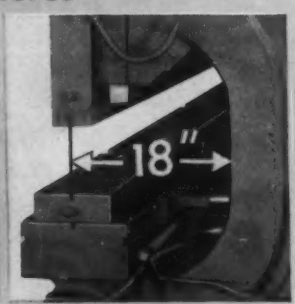
V-shaped slides and guides eliminate loose gibbing. Take up wear automatically. Easily removed and replaced.



SW-304

Six Large Main Bearings

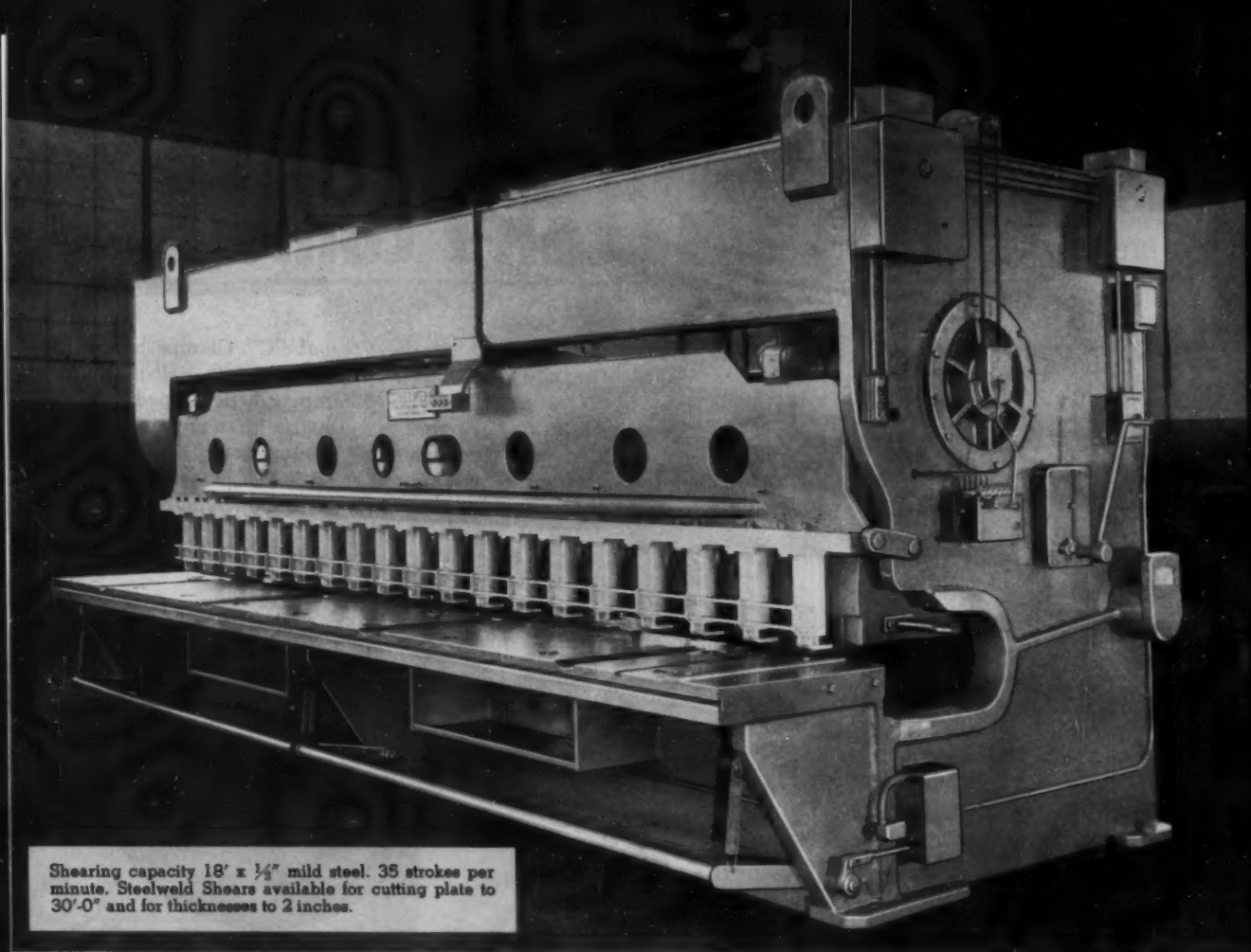
Each of the two eccentric shafts which drive the ram has three heavy bronze bearings. Ram adjustment is made by revolving nut. Screws do not turn; therefor, ball joint wear is reduced.



SW-441

Extra Deep Throat

18-inch throat is standard on all Steelweld Brakes. This permits making bends to 18 inches from edge of plate for full length of dies.



Shearing capacity 18′ x ¼″ mild steel. 35 strokes per minute. Steelweld Shears available for cutting plate to 30′-0″ and for thicknesses to 2 inches.

FOR **HEAVY DUTY** SERVICE

Many Important Shear Advantages

1. Pivoted blade operation.
2. No slides or guides to wear.
3. Knife clearance easily adjusted to suit plate thickness.
4. Smooth, sharp accurate cuts.
5. Low rake.
6. Negligible twist, camber and bow in cut pieces.
7. Fast cutting and high production.
8. Easy and simple to operate.
9. Convenient electric foot control.
10. Trouble-free mechanical hold-downs.
11. Easily arranged for squaring, slitting and notching.
12. Convenient, accurate, ball-bearing mounted back gauge.
13. Quiet operating.
14. Designed for safety throughout.
15. Long knife wear between grindings.
16. Knives easily removed and replaced.
17. All-welded one-piece frame with bed integral.

GET THESE BOOKS!

Catalogs No. 2010 (Brakes) and No. 2011 (Shears) give construction and engineering details. Profusely illustrated.

THE CLEVELAND CRANE & ENGINEERING CO.

5457 EAST 282ND ST. *WICKLIFFE, OHIO*

STEELWELD

BRAKES and SHEARS

New ARMSTRONG Swivel Pad can't come off

Now ARMSTRONG deep throat "C" Clamps have the new (Pat. apd. for) ARMSTRONG Ball-joint Swivel Pad. This "C" Clamp pad, developed by ARMSTRONG Engineers, is tougher than any on the market. Rigorous testing in our own plant first proved this fact, and field tests in factories throughout the country have confirmed our own test results.

Here's Why it's STRONGER . . .

The lip of the opening in the ARMSTRONG Ball-joint Swivel Pad is undercut so that when the ball of the screw is inserted, and the lip is permanently forced down, a solid steel wall is formed, inside the pad cavity, completely encircling the ball.

This wall of steel makes it impossible for the pad to come off the screw during normal use. In fact, our tests have proved that it is virtually impossible to intentionally knock the pad off with a hammer —yet the pad is free to swivel through an arc of approximately 40°.

Call your ARMSTRONG Distributor

Your ARMSTRONG Distributor can offer delivery from stock on this "400-Series" deep throat, drop-forged "C" Clamp with the new Ball-joint Swivel Pad. He also carries in stock the other styles of clamps in the ARMSTRONG Line—the broadest line of drop forged "C" Clamps.

ARMSTRONG BROS. TOOL CO., 5213 W. ARMSTRONG AVE. CHICAGO 46, ILLINOIS

XLO EX-CELL-O FOR PRECISION

C

A

D

F

A. Standard DB 24 Spindle
B. DB 50 Motorized Spindle
C. DB 25 Square Body Spindle
D. DB 50 Motorized Quill-Type Spindle
E. DB 22 Square Body Spindle
F. Standard DB 22 Spindle

E

57-90

Greater Accuracy—with Ex-Cell-O Precision Boring Spindles

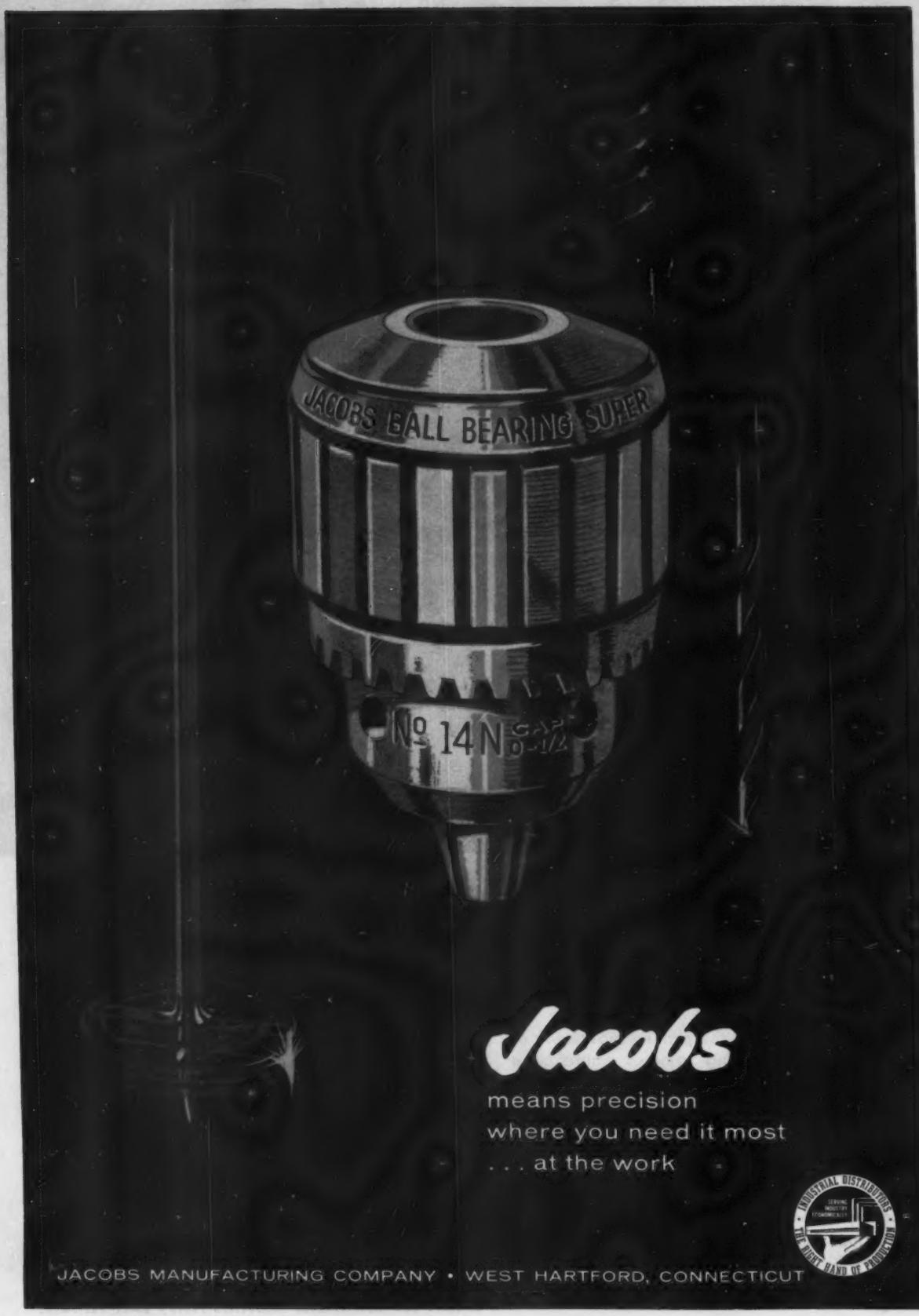
No one need tell you of the proven superiority of Ex-Cell-O precision boring spindles where close tolerances and fine finishes are required. But, did you know that these same Ex-Cell-O boring spindles have been used as replacement units for years?

Produced in belt-driven, standard motorized, or high frequency motorized styles, these Ex-Cell-O precision spindles are equipped with XLO Precision bearings for maximum spindle rigidity, long life and smooth operation. Permanent bearing lubrication reduces maintenance costs, prolongs bearing life.

For complete information, why not get in touch with your local Ex-Cell-O representative or, if you prefer, send direct for bulletin 25477.

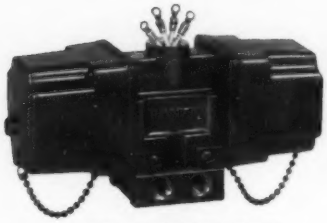
EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES
CUTTING TOOLS • TORQUE ACTUATORS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS
AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT


JACOBS BALL BEARING SUPER
No. 14N
Jacobs
means precision
where you need it most
. . . at the work
INDUSTRIAL DISTRIBUTORS
JACOBS MANUFACTURING COMPANY • WEST HARTFORD, CONNECTICUT

SAVE TIME, AIR, MONEY

with PARKER-HANNIFIN One-Source Engineering



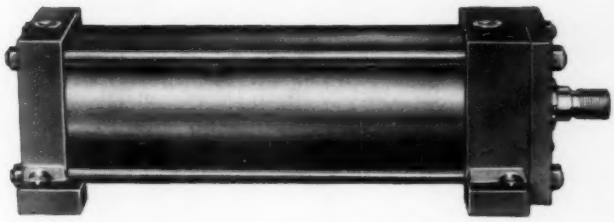
DUAL SOLENOID, 4-WAY

CAM, 3-WAY

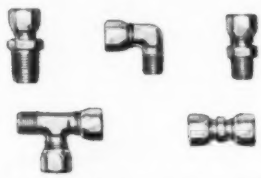
PRESSURE, 3-WAY

HAND, 4-WAY

Use flow factors as money-savers – your Parker-Hannifin man can show you how. They help you to avoid "oversizing" your valves. Hannifin's new Valve Finder gives "C_v" ratings for every valve in the line, makes it possible for you to take full advantage of the extra air-flow capacity in Hannifin air valves. Get your copy today.

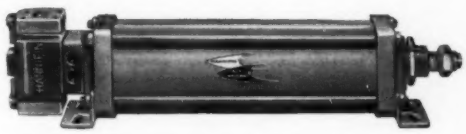


Low friction, long packing life are money-saving features of the Hannifin Series "A" pneumatic cylinder, available in a full range of mounting styles and from 1½" to 14" bore, strokes to 20 feet. Hannifin cylinder application data and charts make selecting the right Series "A" cylinder easy. Get yours from your Parker-Hannifin man.

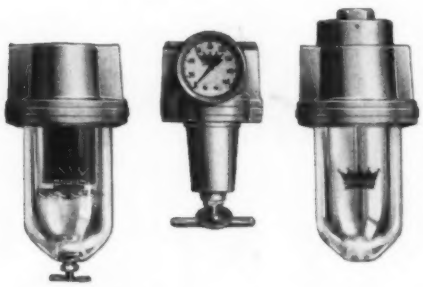


Pneumatic systems tube up fast with Parker "Intru-lok" tube fittings. Use them with copper, nylon or "Parker-POL" polyethylene tubing. Just insert the tube and tighten the nut for a leakproof "bite-type" joint.

Another time-saver is "Push-lok", the Parker hose-and-hose-fittings combination for pressures to 250 psi. No tools needed. Just push this hose on these hose fittings. They won't blow off, ever, not at twice 250 psi.



One air line conection installs the Hannifin Air Motor... an integral solenoid valve controlling a fast, rugged double-acting air cylinder. Built-in speed controls adjust piston speed in either or both directions.



You will save both air and money with Hannifin "Crown" air line filters, pressure regulators and lubricators. Let your Parker-Hannifin man show you how they pay for themselves by making it possible to get all the air flow you need at the exact pressure that will best do the job. "Crown" filters and lubricators will bring further savings through reduced equipment maintenance.

Your pneumatic system shapes up faster at the design stage when one man can discuss with you every component you'll need. But have you realized how much your Parker-Hannifin man can save you in money and air?

Just for instance... your valves don't have to be ¾" just because the cylinder size you select comes with ¾" ports. Your Parker-Hannifin man chooses valve types and sizes to suit the air flow you'll need. He'll show you, too, how pressure control saves money and air, how a smaller lubricator is often a more efficient lubricator, and other money saving ideas. Then he'll show you ways to "tube up" and "hose up" a leakproof pneumatic system quicker, neater and at lower cost.

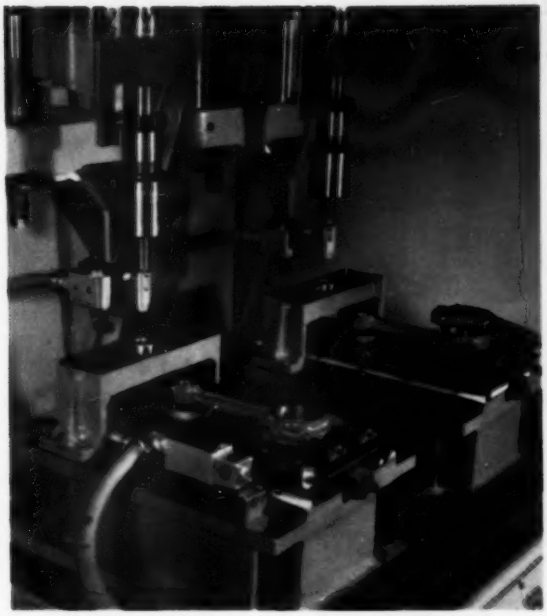
Call your nearest Parker-Hannifin sales office, or write direct for complete information.

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue • Cleveland 12, Ohio
HANNIFIN COMPANY
A DIVISION
509 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

3139-PH

NATCO
NATCO

Short-bore production honing finally gets its own machine tools—sturdy Natco/Jes-Cal mechanical honing machines built to maintain honing tolerances under continuous production conditions.



NEW

Natco Heavy Duty Production Honing Machines

Pinion gears, connecting rods, rocker arms, compressor components—Natco/Jes-Cal mechanical honing machines have been developed for better honing of just such parts as these.

These new machines are designed to use production-proven Jes-Cal honing tools with the exclusive, automatic, plug-gage method of size control. Add the sturdiness and tolerance-holding stability of Natco machine design and you know why these are machines to end your production honing problems.

They will hone any bore from ½″ to 3″ in length and up to 3″ in diameter. Rotational speeds of 200 to 800 rpm and reciprocation from 60 to 240 strokes per minute are fixed by pick-off gears. Stroke length up to 3″ is adjustable in desired increments.

Use them singly or as multiple heads on a common base. Integrate them into your transfer line—they are fully compatible with Natco drilling, tapping, boring, and milling machines. For more facts call your Natco or Jes-Cal representative. Write for Bulletin 200.

The National Automatic Tool Company, Inc., Richmond, Indiana

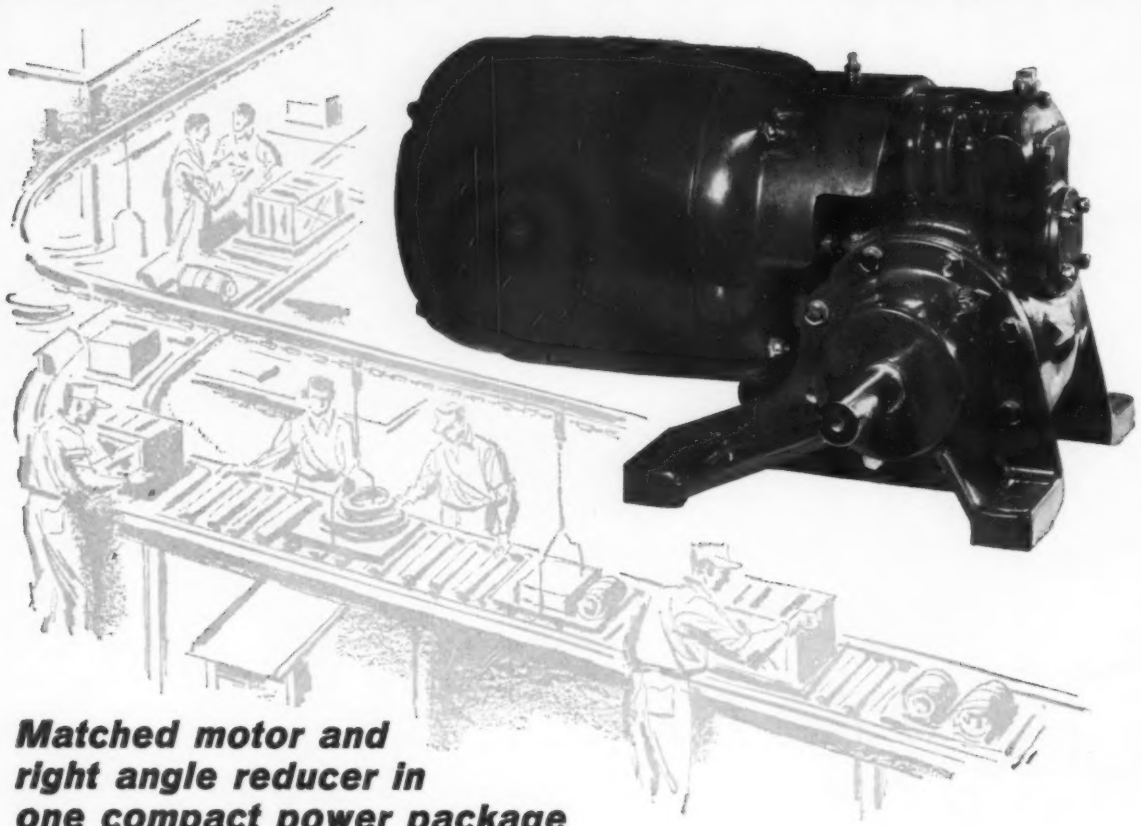
NATCO

Natco/Jes-Cal mechanical honing machines can be set up singly or in batteries on a common base. They are easily integrated into a Natco fully automatic transfer line.

Is your honing problem—or something like it—in this collection? These are typical jobs honed at high production rates on the new all-mechanical Natco/Jes-Cal honing machine.

MASTER GEARMOTORS

simplify applications—save space



Matched motor and right angle reducer in one compact power package

Reduction of engineering and assembly cost . . . elimination of separate components . . . are basic in this Master Right Angle Gearmotor. Consider these specific advantages:

1. No high speed coupling.
2. No V-belts or chains and sprockets.
3. Takes up less space—reduces mounting plates.
4. Special flange or face mounting can eliminate low speed coupling.
5. Saves aisle space . . . drives around the corner.
6. Wide acceptance by machine builder and user.

Master Gearmotors are built with ratings from ⅛ to 125 h.p. . . . in right angle, parallel or in combination. Right angle ratios are available to 96:1; parallel 120:1.

Electrical and mechanical modifications give you a maximum choice—vertical, horizontal, and flange mountings; output shaft over, under, left or right. These gearmotors can be supplied with built-in accessories: a fluid coupling for hard-to-start loads or cycling loads; a brake for fast stops and positive holding.

Call your nearest Reliance Sales Engineer. Let him tell you why more Master Gearmotors are in use today than any other make.

E-1660

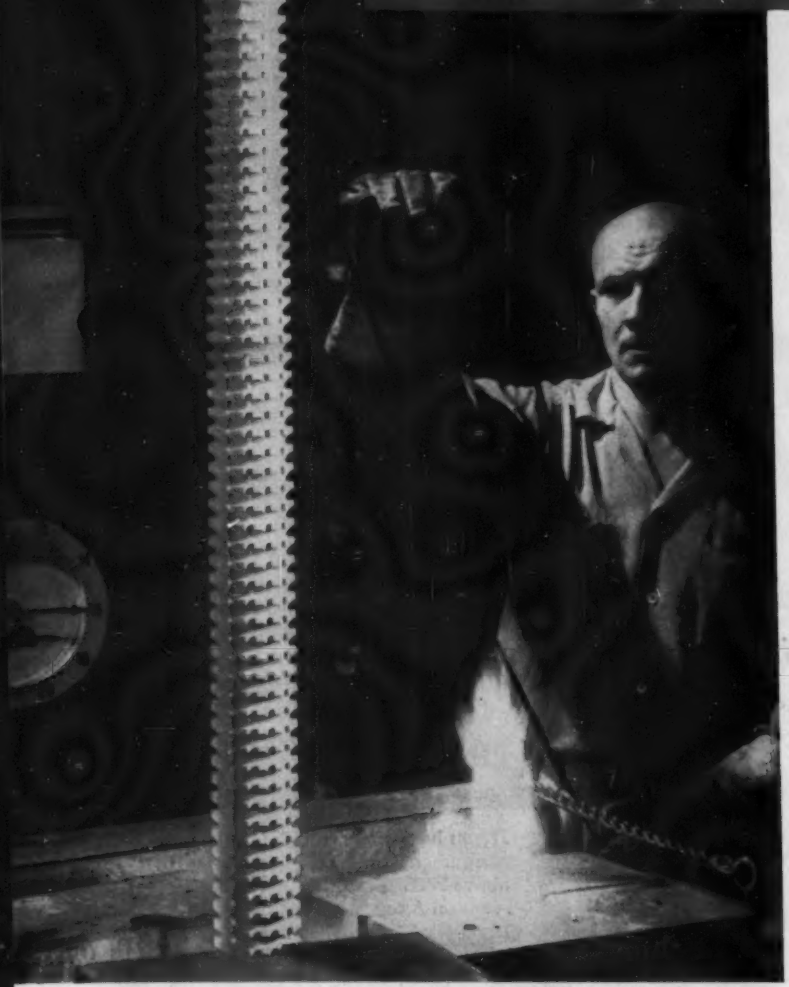
Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 310A, CLEVELAND 17, OHIO
Canadian Division: Toronto, Ontario
Sales Offices and Distributors in Principal Cities

Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V★S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.

CAREFUL!



With the sure, *careful* touch of an experienced hand, veteran CTW heat-treat man hoists 72" broach from a vertical furnace.

Care in the creation of Continental Broaches takes precision manufacturing a step beyond the exactness of quality control. Thirty years of broachmaking—designing and producing thousands of standard und custom-made broaches—assures *unmatched* efficiency and performance from CTW Broaches.

Find out how Continental's experience in broach engineering, modern heat treat methods and cost-saving production processes can cut downtime and increase output in your operation. Call your local Ex-Cell-O representative, or contact Ex-Cell-O Detroit; in Canada, Colonial Tool Co., Ltd., Windsor.

59-14

CTW Continental TOOL WORKS

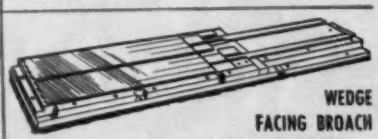
DIVISION OF

EX-CELL-O CORPORATION

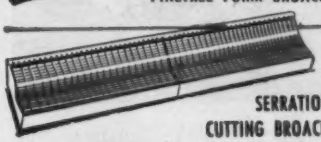
DETROIT 32, MICHIGAN

PINETREE FORM BROACH

SPIRAL SPLINE BROACH



WEDGE FACING BROACH



SERRATION CUTTING BROACH

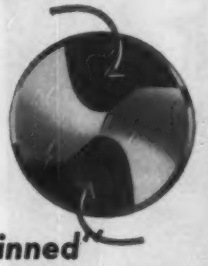
INVOLUTE SPLINE SHELL-TYPE BROACH

CARBIDE-TIPPED BROACH SECTIONS

. . . Why Thin Webs ON HEAVY DUTY DRILLS?

STANDARD'S Technicians corrected the thinning difficulties, previously experienced when using the conventional type heavy duty drill.

. . . the web thinning process is "built-in" the flute contours . . . a design feature that gives . . .



STANDARD'S *"self-thinned"* HEAVY DUTY DRILL*. . .

1. UTMOST ACCURACY . . . no flute or point distortion due to free hand resharpening.

2. CONSISTENT TOOL PERFORMANCE FROM GRIND TO GRIND.

3. MORE SHEAR . . . outer cutting edge more advanced of center.

4. IMPROVED CHIP CONTROL . . shape of cutting edge acts as chip breaker.

*U. S. Patent No. 2,778,252.

STANDARD'S Authorized Distributors Stock-ready for immediate delivery—the COMPLETE FAMILY OF STANDARD QUALITY CUTTING TOOLS, Twist Drills . . . Reamers . . . Taps . . . Dies . . . Milling Cutters . . . End Mills . . . Counterbores . . . Hobs . . . Carbide Tools and Gages.

If you have a real tough machining assignment, especially on hardness above ROCKWELL C-30 (285BHN) . . . or on Alloy Steel, Stainless Steel, Hard Cast Iron, High Temperature Alloys . . . Call your STANDARD Distributor, he has a Practical and ECONOMICAL solution.

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order after order after order... minimum size change and distortion... low temperature heat treating... uniform deep hardenability... freedom from scaling... good machinability... exceptional toughness with good hardness... no preheating in hardening. From start to finish you enjoy exceptional simplicity and safety and predictable performance. Produced by the MEL-TROL® Process... Only Carpenter VEGA-FM assures such uniformity of benefits. Use this MATCHED SET of Air-Hardening Tool and Die Steels—VEGA-FM (Type A-6), No. 484-FM (Type A-2), and No. 610-FM (Type D-2)—for proper selection and consistently better results. Call your Carpenter SERVICE-CENTER for prompt delivery.

Carpenter steel

you can do it ***consistently*** better with Carpenter Tool and Die Steels

The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.

Fully Automatic
FORGING MACHINE
DELIVERS 45 PIECES PER MINUTE!

The illustration above shows a 2" HILL ACME Automatic Forging Machine with an induction heater producing ⅝" and ¾" mine roof bolts, in lengths from 12" to 72", at the rate of 45 pieces per minute in sustained operation. Bars are loaded into the feeding rack where an index feed, chain driven, positions them for proper spacing through the induction furnace. As the bar ends are heated they are delivered, at the proper timing cycle, to the forging machine by a roller chain feed where they are gauged for length, picked up by fingers and passed progressively through the dies. Finished forgings are discharged from the back of the machine by means of a separately driven conveyor, arranged for both right and left hand discharge.

The design of this new HILL ACME AUTOMATIC forging unit does not limit the number of passes or the length of stock to be used in forging a variety of parts. Pieces longer than 36" are supported by a walking beam through the various passes.

HILL ACME AUTOMATIC forging machines are built in 1¼" to 5" capacities all of which can be automated. Your inquiry concerning high speed automatic forging equipment will receive prompt attention.

The HILL ACME Company

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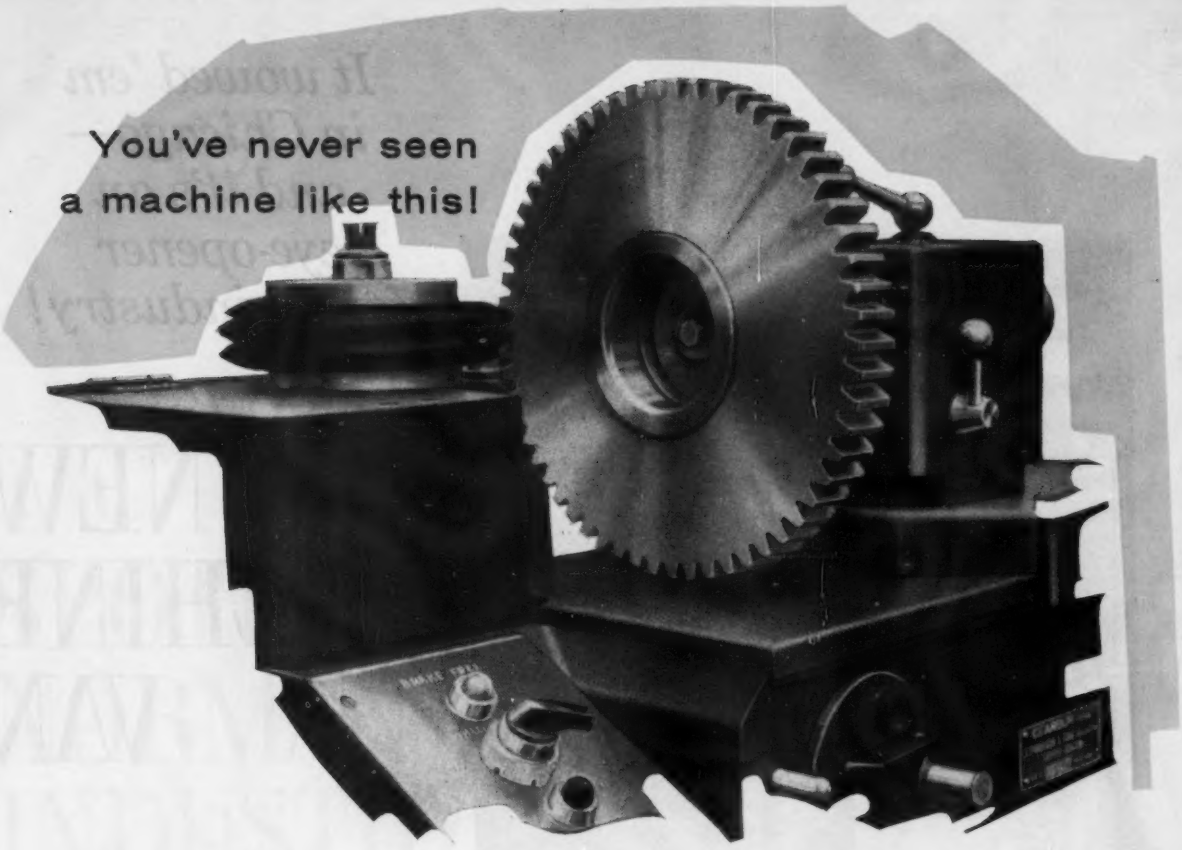
Manufacturers of: "ACME" FORGING • TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • ROTARY SHEARS • BAR-BILLET SHEARS • "HILL" GRINDING AND POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • "CLEVELAND" KNIVES • SHEAR BLADES • MATERIAL HANDLING EQUIPMENT

We now manufacture, distribute and service the entire line of KLING metal working tools.

You've never seen a machine like this!



LAPOINTE PARKINSON

Gearbur

removes the sharp edges and burrs from the sides of spur and helical gear teeth *more evenly than by hand — far more rapidly than by hand*

It's a chamfering method of de-burring.

Turns minutes into seconds, saving hours of hand work in removing burrs smoothly, correctly, quickly — even after hardening! One profiled grinding wheel will de-burr gears of different numbers of teeth of the same pitch and pressure angle, and will de-burr a large number of gears before requiring re-dressing. Capacity: Gears up to 11" dia. x 11" long with teeth 25 D.P. to 5 D.P.

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HUDSON, MASSACHUSETTS

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PRECISION MACHINE TOOLS

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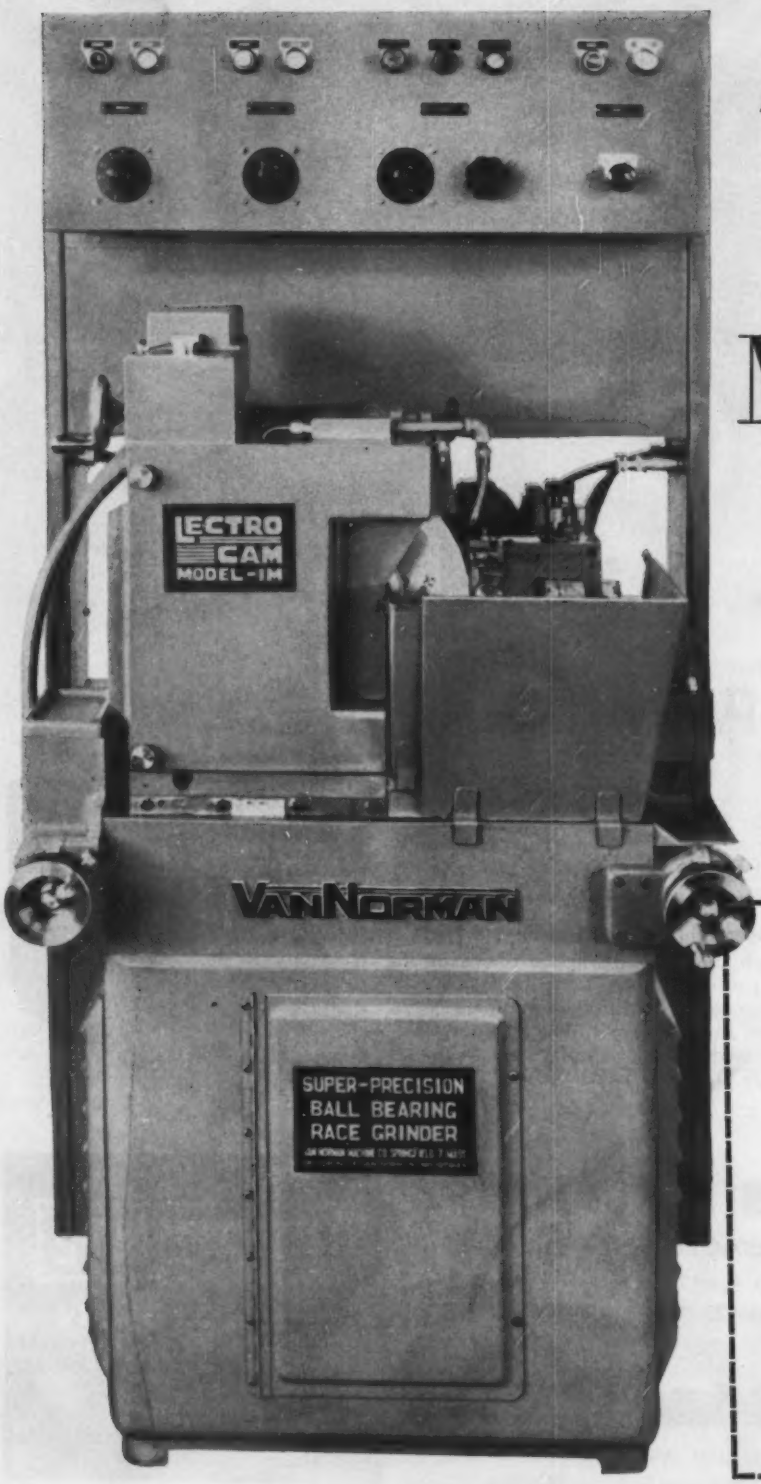
It wowed 'em in Chicago— and it's an eye-opener for all industry!

NEW MACHINE VAN



One of the biggest draws at the MACHINE TOOL BUILDERS' EXPOSITION

All-New VAN NORMAN MINIATURE BEARING GRINDER

...plunge-cut radius grinder specifically designed to meet the requirements of the bearing industry for fast, easy, precision grinding of ball grooves on inner races of miniature bearings.

SPOTLIGHTS NORMAN POLICY OF "INDUSTRY-INTEGRATED DESIGN"

Production Benefits Most-Wanted by Each Industry Supplied by Machines Engineered to the Industry's Specific Requirements.

Van Norman "Industry-Integrated Design"— as typified by the new Model-1M Lectro-Cam Miniature Bearing Grinder—offers every industry the machines it needs for higher production, finer precision and greater savings. This broad Van Norman program is based on your own specific requirements, engineered with Van Norman know-how and skill into production tools that do the best job for *you*.

Widely versatile Van Norman engineers will work with you, and with your men at the management, engineering and production levels. You'll find that Van Norman Machine specialists speak your language. Their preferred approach to any particular machining problem is one of close cooperation with the responsible people at every stage of the design and development of a new machine tool. Your own ideas and suggestions are carefully studied, and ways are sought to incorporate them as solid benefits through sound Van Norman design principles accumulated during more than six decades.

Whatever your machine requirements, you will get all-round efficiency through Van Norman "Industry-Integrated Design." Let us know your needs. Contact Van Norman Factory or Van Norman Local Machine Tool Distributor.

2608

VAN NORMAN MACHINE COMPANY

VN

SPRINGFIELD 7, MASSACHUSETTS • A DIVISION OF VAN NORMAN INDUSTRIES, INCORPORATED

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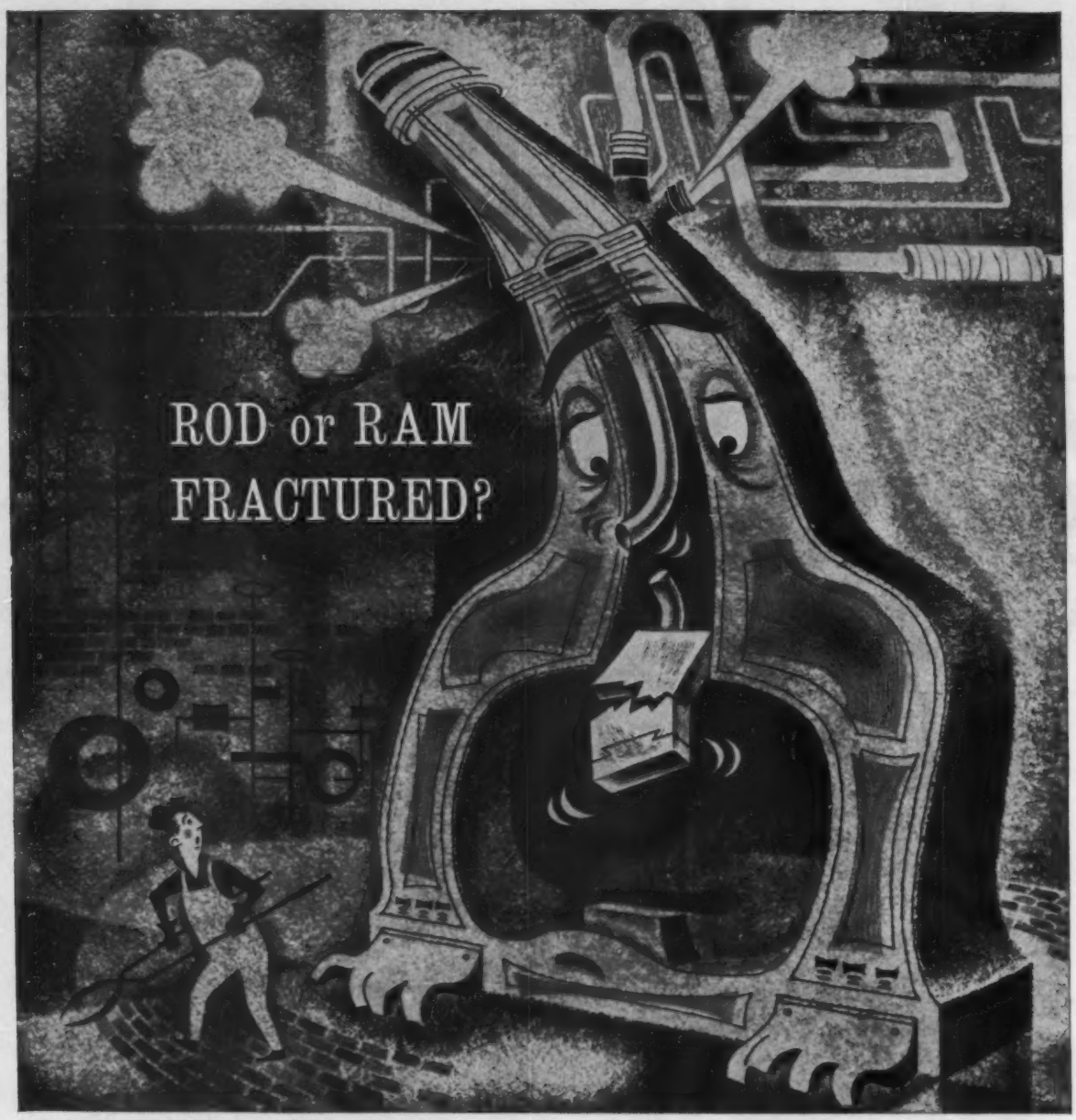

Call ERIE FOUNDRY for forging hammer replacement parts to your specifications

Replacement rods and rams, and many other parts for a wide variety of forging hammers of most any make are available from Erie Foundry. They are high in quality, competitive in price.

For over 65 years Erie Foundry has specialized in the design, development and manufacture of forging hammers of all types. Logically, then, Erie Foundry is a sure source for repair parts equal in quality and performance to the original equipment. Substantial inventories assure you of prompt service.

For more information on repair parts or our complete Rebuilding Service, write Mr. James Walker.

Manufacturers of Forging Hammers • Forging Presses • Hydraulic Presses • Trimming Presses

ERIE

ONE OF THE GREAT NAMES IN FORGING SINCE 1895

ERIE FOUNDRY CO., Erie, Pa.

EF-46-01

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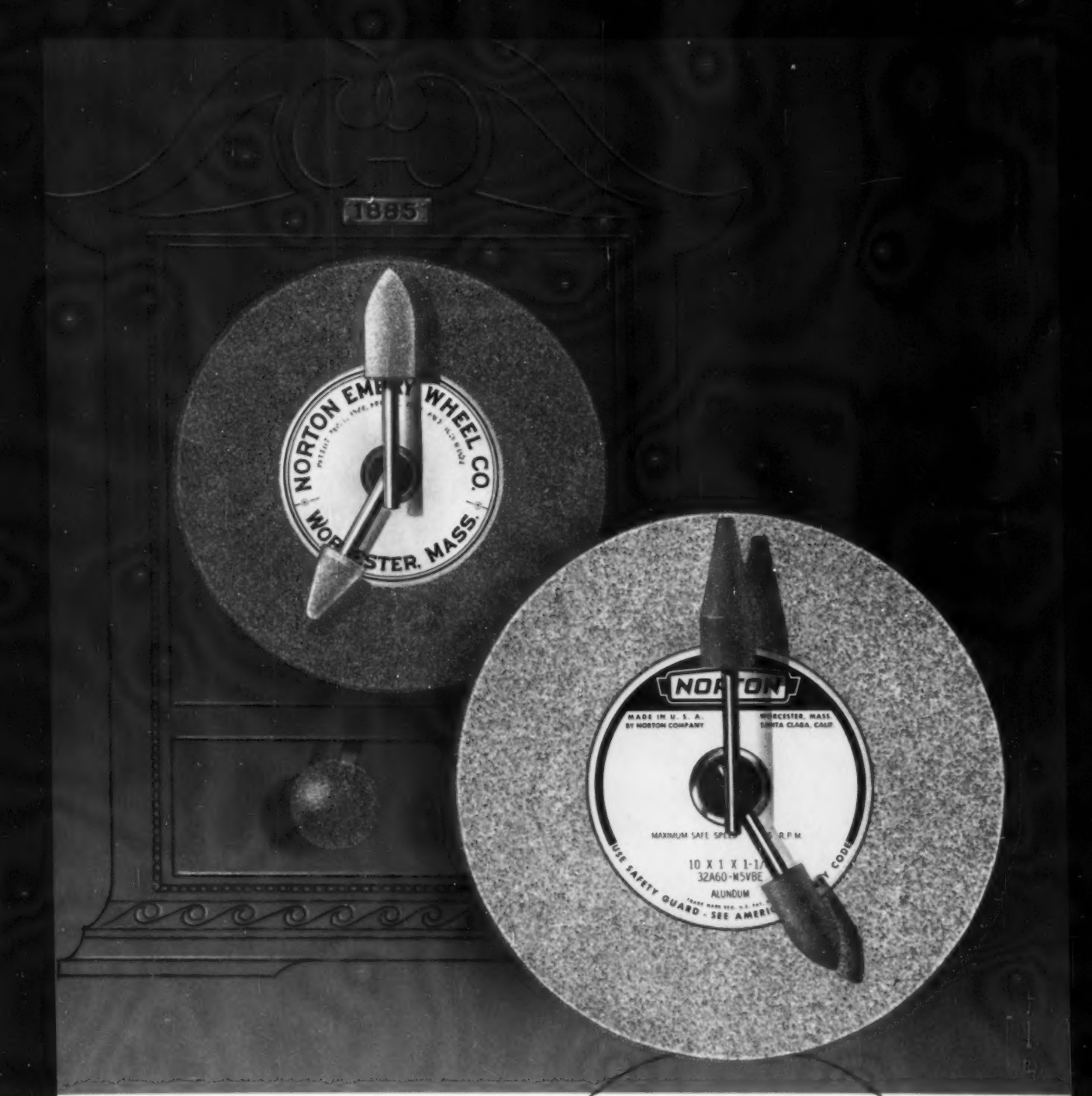

75 years... a lifetime of progress

The Norton story begins in the dim past, farther back than 1885. But it was in that year that a group of forward looking industrialists founded the Norton Emery Wheel Company in Worcester, Massachusetts.

Today, Norton Company looks forward with equal confidence to its continued growth under sound financing, progressive management and with loyal employees. And it looks back with pride upon 75 years of steady progress in developing and applying the world's largest line of abrasives to meet the needs of industry.

It's your Norton Man's
75th ANNIVERSARY, *too*

To say that "it's your Norton Man's 75th Anniversary, too," has nothing to do with his age. But it has a good deal to do with his qualifications as your production consultant. For the experience of Norton Company — since its founding in 1885 — is, in a very real sense, his own personal background.

For example, your Norton Man's thorough training at the Worcester Plant is based on the Company's 75 years of developing the world's largest line of abrasive products — including the widest range of grinding wheels, from mammoth pulpstones to miniature mounted wheels; discs and segments; abrasives for polishing, lapping, tumbling and pressure blasting.

Typical Norton Advancements

Norton was first to introduce all three bond types of diamond wheels, and now uses man-made as well as mined diamonds to meet today's broader needs . . . introduced NORBIDE® boron carbide, next to diamonds the hardest material ever made by man for commercial use . . . and the latest Norton advancement is the opening of another new five-acre plant, built for the sole purpose of using new, modern methods to manufacture resinoid bonded wheels, favorites among foundries and other users. Besides developing these and many other types of abrasive products, Norton has constantly improved grinding techniques throughout industry.

Your Norton Man's Heritage is this wealth of technical know-how gained by Norton in 75 years, backed by his own practical training and field experience. As your Abrasive Engineer, this combined background qualifies him to give you expert advice on the selection and use of grinding wheels. He'll supervise test runs of wheels in your plant and will give you every aid in bringing the lowest cost-per-piece to your production economy.

Nation-Wide Deliveries and Service

In the United States, Norton manufactures in Worcester, Mass., and Santa Clara, Cal. and maintains immense factory stocks plus warehouse stocks in five conveniently located cities. Norton distributors in 283 cities keep their stocks fully adequate to the needs of their areas. For prompt deliveries, helpful service, and contact with your Norton Man, call your Norton distributor.

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ABRASIVES

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*Warehouse Facilities and Stocks at this location

BEHR-MANNING CO., Troy, N.Y. is a Division of Norton Company

75 years of . . . Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

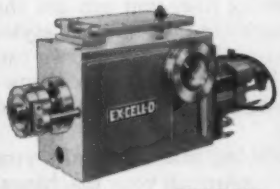
4-60

IMMEDIATE DELIVERY

STYLE 28-A
HYDRAULIC POWER UNIT

STYLE 22
HYDRAULIC POWER UNIT

STYLE 20
HYDRAULIC POWER UNIT



STYLE 502
LEAD SCREW TAPPING UNIT

Ex-Cell-O Hydraulic Power Units in Stock Now to Cut Your Machine Tool Lead Time and Production Costs!

Reduce lead time, increase productivity, and cut per-unit cost with Ex-Cell-O Quill-Type Hydraulic Power Units—immediately available for drilling, counterboring, spot-facing, and reaming operations, or as prime movers for milling equipment.

Ex-Cell-O Hydraulic Power Units are self-lubricated . . . built for easy installation, and trouble-free operation, even under fast cycles and continuous production. Compactness allows close center distance installation, in-line or radial . . . versatility makes them ideally suited for special-purpose, high production machines. A companion product, the Style 502 Tapping Unit, uses a lead screw for trouble-free tapping.

See your Ex-Cell-O representative or write direct for full information on the complete line of Hydraulic Power Units and our Canadian-built Lead Screw Tapping Unit.

EX-CELL-O FOR PRECISION

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • BROACHING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • ATOMIC ENERGY EQUIPMENT • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

60-43

For more data circle this page number on card at back of book

New Kendex* Dial-A-Breaker* permits close ganging of tools. All adjustments, chipbreaker and insert, can be made from the top of the holder.

The machine tool you buy is no better than its cutting tool

You may have looked at many ingenious machines and wizard-like controls at the Chicago Show. Perhaps you bought one . . . or are planning to . . . in the hope of increasing production, improving products or reducing costs. *But the final return on your machine investment depends upon the tooling.*

It doesn't pay to spend thousands of dollars on machines . . . then try to save a few pennies when tooling up

Whether the machine is one of the latest, high speed, numerically controlled types or an older model . . . you will make more, products and dollars, by equipping it with the BEST tools you can buy.

The best tooling is especially important for machines operated by numerical controls. Inserts must be of uniform quality for predictable service life. Toolholders must be designed for quick indexing of inserts and fast adjustment of chipbreakers . . . to minimize set-up time, improve accuracy and reduce scrap.

The new Kendex Dial-A-Breaker, shown above, is especially well suited for automated operations. Its attached, quick-adjusting chipbreaker shortens set-up time, speeds insert indexing, assures optimum chip control and eliminates the need for a different chipbreaker for every job. *Only two sizes of chipbreakers are needed to service 76 styles and sizes of holders.* The Dial-A-Breaker eliminates chipbreaker grinding, simplifies stocking.

From the versatile Kendex line, you can get the tool best for every job. There are 110 standard styles and over 400 toolholders to select from. Or, we can help you develop special heads with Kendex throwaway inserts that may permit several operations to be performed in one pass.

For maximum production, make certain you have the most productive tooling on your machines. Call your Kennametal Representative. His only job is applying Kennametal* hard carbides to tooling and specialized uses. KENNAMETAL INC., Latrobe, Pennsylvania.

*Trademark

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INDUSTRY AND
KENNAMETAL
...Partners in Progress

Specify HARDINGE Collets for Accuracy and Durability

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"Performance Has Established Leadership for HARDINGE"

For Your LATHES and MILLING MACHINES

HARDINGE Draw-in Collets symbolize accuracy, long life, and low cost because they are hardened and ground both internally and externally, have heat treated threads, — and cost no more than ordinary collets.

HARDINGE Collets assure you of all - essential accuracy plus durability and economy.

Write for Free Bulletin — Complete collet ordering information for all Lathes and Millers.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

Immediate stock delivery from Atlanta, Boston, Chicago, Dayton, Detroit, Elmira, Hartford, Los Angeles, New York, Philadelphia, Seattle, Portland, Minneapolis, Oakland, St. Louis, Springfield, N. J., Toronto.

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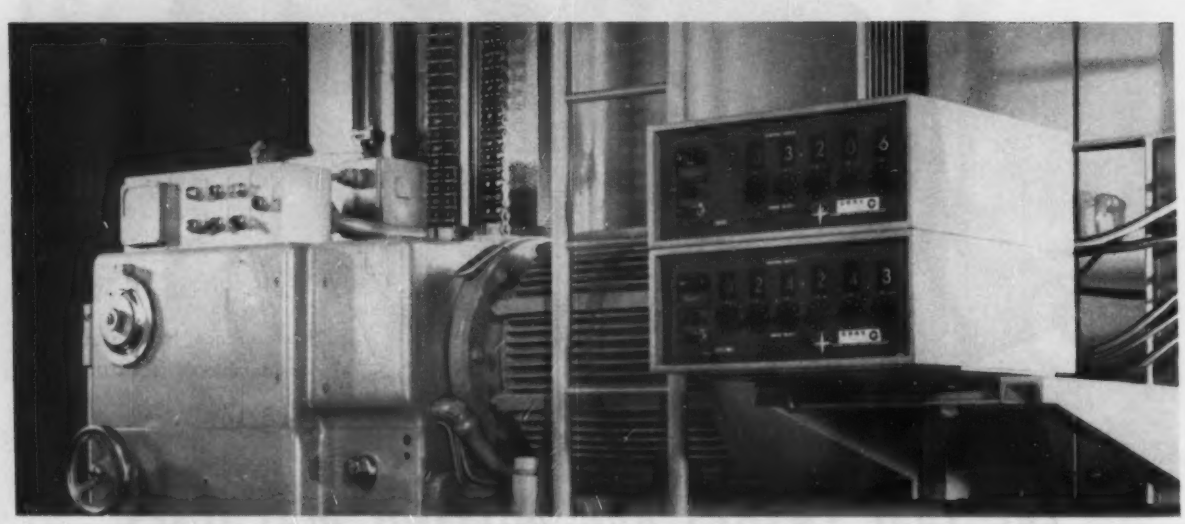
NORDEN Modumatic Control for New and Existing Machines

Series 100 features

- ★ Actual Position Readout
- ★ Decimal Display
- ★ Full Range Origin Select



IF you have the time-consuming problem of rotary or linear positioning, then you are aware of the importance of knowing the exact location of the tool or the work piece. Up until now this was a tedious, time-consuming process requiring calculation and dial reading, both subject to human error. Norden's Series 100 display system eliminates all this and performs the calculations automatically. What's more, it can be installed on **new** and **existing** machines.

The Series 100 numerical control system utilizes a unique position feedback transducer, electronic circuitry and a visual display to indicate the **actual** position of the tool or work piece.

The **actual** position is displayed in straight decimal form by illuminated numbers that are readable from twenty feet. The display unit may be located on the machine or remote.

This Norden Modumatic system also offers a full range electronic origin select so that any desired offset can be quickly and easily dialed in by the operator on manual selector switches.

For more information about this position display system or other Modumatic control systems contact your nearest Norden Representative—400 Main Street, East Hartford, Connecticut, JAckson 8-4811, 11 West Monument Ave., Dayton 2, Ohio, BAldwin 8-4481, or write to us at the address below.

A new concept in Numerical Control from ★ **NORDEN** ★ **DIVISION OF UNITED AIRCRAFT CORPORATION**
DATA SYSTEMS DEPARTMENT
COSTA MESA, CALIFORNIA

WESTERN UNION TELEGRAM

W. P. MARSHALL, PRESIDENT

1201

SYMBOLS
DL = Day Letter
NL = Night Letter
LT = International Letter Telegram

CLASS OF SERVICE
This is a fast message unless its deferred character is indicated by the proper symbol.

The filing time shown in the date line on domestic telegrams is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

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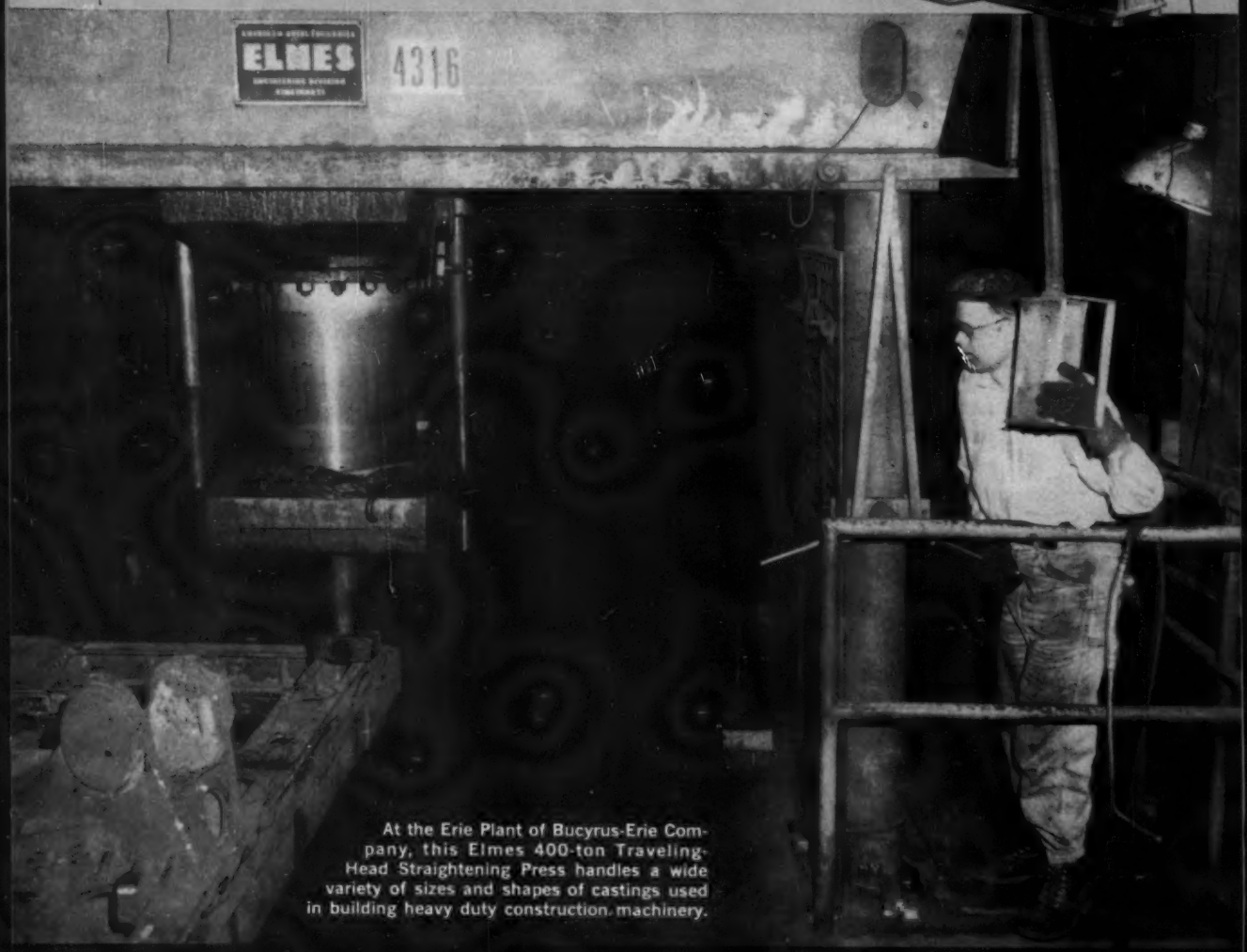
WUX ERIE PENN MAY 12 348P EDT
AMERICAN STEEL FOUNDRIES, ELMES-KING DIVN
CIN
OUR ELMES STRAIGHTENING PRESS IS A BIG FACTOR IN COST CONTROL BECAUSE OF ITS SPEED MANEUVERABILITY, AND NEGLIGIBLE MAINTENANCE REQUIREMENTS
BUCYRUS ERIE CO R C BYERS



At the Erie Plant of Bucyrus-Erie Company, this Elmes 400-ton Traveling-Head Straightening Press handles a wide variety of sizes and shapes of castings used in building heavy duty construction machinery.

ELMES Hydraulic Presses and Equipment

KING Vertical Boring and Turning Machines

American Steel Foundries/ELMES-KING Division, 1150 Tennessee Avenue, Cincinnati 29, Ohio

—angles

—tapers

—contours

LeBlond Tape-Turn

FULL NUMERICAL CONTOUR

• solid state circuitry • no computer needed
• no hydraulics and heat exchangers
• no vacuum tubes • no templates

—plunge cuts

—facing cuts

—straight cuts

—radii

TURNING

Slopes, curves, straight cuts, angles, radii, tapers, facing cuts, boring cuts — you name it, this new LeBlond Tape-Turn Lathe can do it. And without steps, apologies, or a computer.

LeBlond Tape-Turn Lathes are all heavy-duty models with a special headstock and carriage engineered for General Electric's new Mark Century tape control. This potent combination can easily cut tracer turning time by half.

Here's all the stamina, power, and versatility you need for production work, coupled with the simplest contouring control yet developed. Uses 8-channel paper tape just like common positioning controls.

Requires only a sine-cosine table for programming slopes, and no special aids for straight cuts or curves. The console is equipped with a pushbutton keyboard for overriding the taped program.

Continuous path control — no steps. Screw cutting mechanism and control provision for curves with radii greater than 10" available on special order.

Ask a LeBlond representative today for a demonstration on one of your turning jobs. With LeBlond you cut with confidence.

The R. K. LeBlond Machine Tool Co.

Madison at Edwards Roads, Cincinnati 8, Ohio

LeBLOND of Cincinnati

He's Watching a Band Sawing Miracle

This band saw operator at the Bell & Gossett Company plant in Morton Grove, Illinois, is watching "Controlled Accuracy". . . accuracy, being held to within a few thousandths of being perfectly straight, and he can actually *see* the band blade being guided in the saw cut to produce this accuracy! No further machining is required before the pipe is welded into an assembly for a Bell & Gossett Heat Exchanger Unit.

Band sawing accuracy like this is nothing short of miraculous—especially when it can be done on a high production basis, as Bell & Gossett is doing. And when the same tolerances can be held on cut-off pieces from 2" to 18" in diameter, this MARVEL #81 Band Saw Machine can be truly called a precision machine tool.

The secret of this amazing sawing accuracy is in the MARVEL "SURE-LINE" Automatic Accuracy Control—a simple and extremely effective electro-mechanical servo-mechanism that continuously senses and automatically corrects any tendency of a band blade to drift to either side of a desired line of cut. The "SURE-LINE" unit literally "steers" the blade to make a straight cut. This permits the use of heavier feed pressures and, when desirable, higher blade speeds, to do the work faster, without sacrifice of accuracy. Incorporated in the new MARVEL #81 Series High Speed Heavy Duty Hydraulic Band Saws, the "SURE-LINE" permits full utilization of all the advantages of high speed steel band saw blades—while extending their usable blade life as much as 50%.

Before you buy any band saw machine, get complete details on MARVEL #81 Series Single Cut, or Automatic Shuttle Type Bar Feed Production Band Saws—the machines DESIGNED AND BUILT TO REDUCE SAWING COSTS. *Write for catalog today.*

ARMSTRONG-BLUM MANUFACTURING CO.
5700 West Bloomingdale Avenue • Chicago 39, Illinois

MARVEL *Metal Cutting* SAWS
Better Machines—Better Blades

When you think of
FLEXIBILITY

Lucas provides

Lever control.

Pendant control

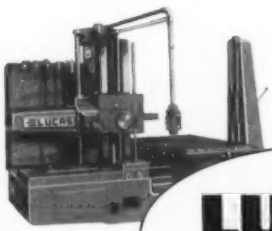
Tape control

and a variety of combinations of the three for flexibility of control suited to the type of work required.

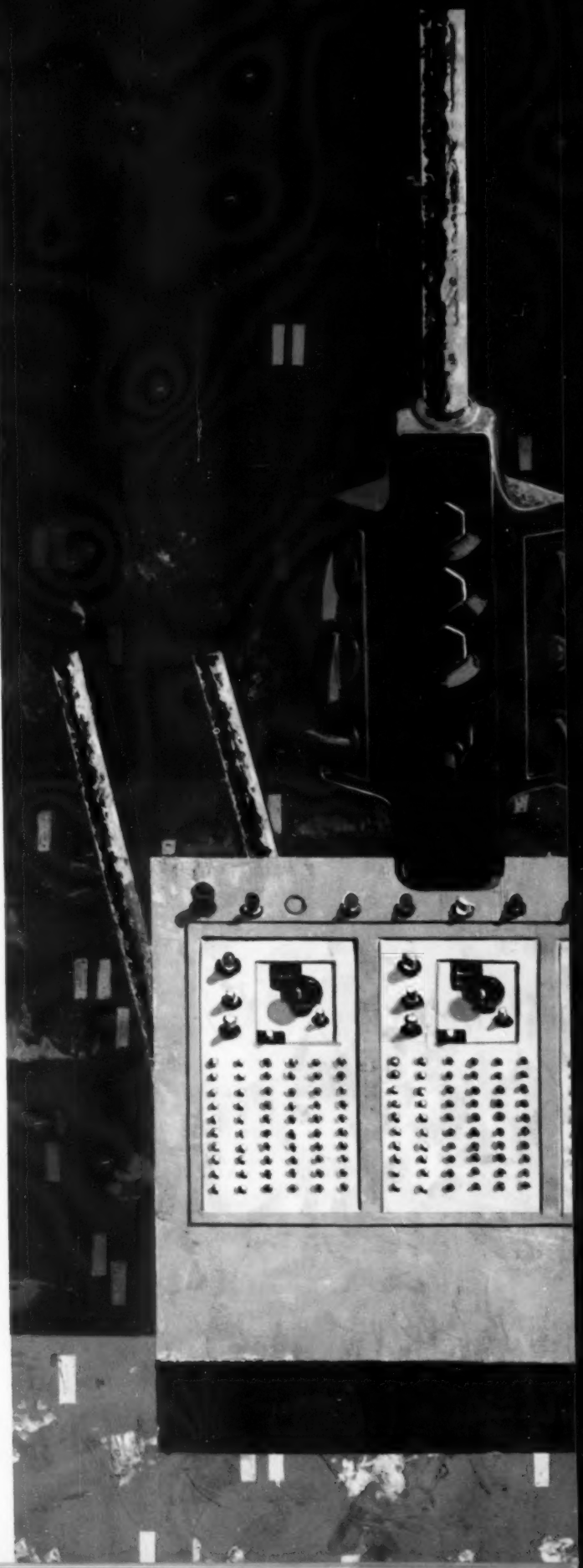
For example . . . The Multiple Control Pendant selects speeds, feeds, unit travels, rapid traverse of head, table, saddle and spindle, plus the rotation of the spindle forward and reverse, jog and stop. Speeds and feeds can be pre-selected while the machine is in operation.

Practical applications of these controls are spelled out in a new catalog. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of flexibility . . .

think of . . .



LUCAS
PRECISION



When you think of VERSATILITY

Lucas feeds the saddle ⇐

Lucas feeds the spindle ⇒

Feeds both in combination ⇒⇐

when necessary.

Combine these motions with

Vertical spindle head travel ⇕

and horizontal table travel ⇔

and a rotary table ↻

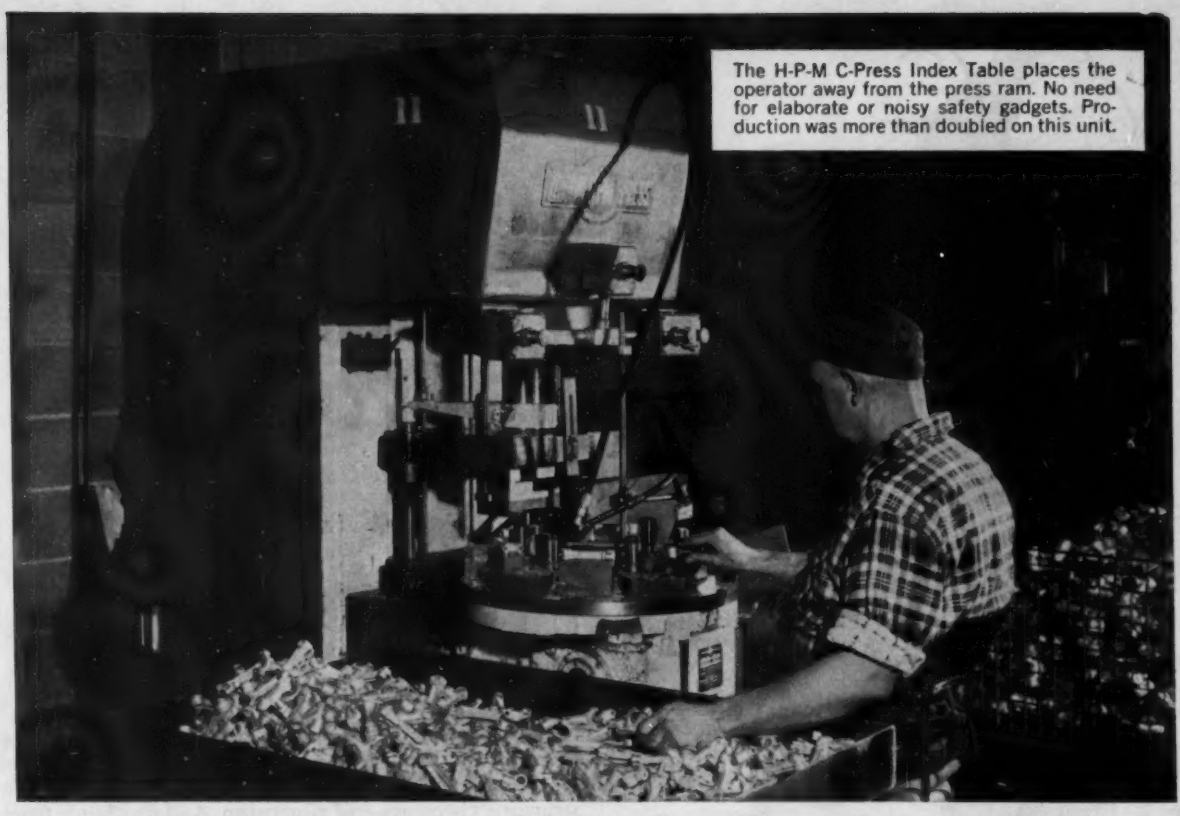
if you need it.

The result . . . no machine tool can offer a greater combination of usable motions for boring, drilling, milling and related work.

Over twenty models and a dozen major attachments. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of versatility . . .

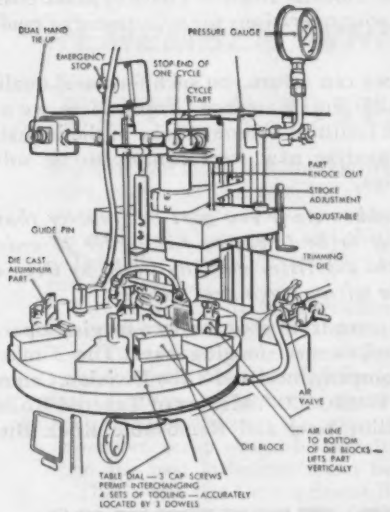
think of . . .

LUCAS
PRECISION



The H-P-M C-Press Index Table places the operator away from the press ram. No need for elaborate or noisy safety gadgets. Production was more than doubled on this unit.

H-P-M C-Press with Hydraulic Index Table
BASIC AUTOMATION AT ITS BEST


DUAL HAND TIE-UP
PRESSURE GAUGE
EMERGENCY STOP
STOP-END OF ONE CYCLE
CYCLE START
PART KNOCK OUT
STROKE ADJUSTMENT ADJUSTABLE
GUIDE PIN
DIE CAST ALUMINUM PART
TRIMMING DIE
AIR VALVE
AIR LINE TO BOTTOM OF DIE BLOCKS — LIFTS PART VERTICALLY
DIE BLOCK
TABLE DIAL — 3 CAP SCREWS PERMIT INTERCHANGING 4 SETS OF TOOLING — ACCURATELY LOCATED BY 3 DOWELS

Standard 15-ton C-Press with 6-station index table. 5, 10, 15-ton models with 6, 8 or 12 station tables available. A solid money-making investment for faster, safer metal working.

The job illustrated is tooled for the trimming of die cast parts. Its high-production capacity can be applied to any number of routine production tasks. Look at these versatile features: (1) The index table allows the operator to load parts away from the press ram—in safety and comfort, no wasted waiting time while ram cycles; (2) As many as three operators may be located around this small table for assembly or other operations; (3) Automatic ejection, using air from shop lines makes an effective and time saving contribution to faster production; (4) The die blocks or holding fixtures are located at six stations on this unit. Table dials are dowelled in position for accuracy — may be removed so that different tooling set-ups are replaced in a matter of minutes. Production can be tripled with this type of C-Press.

SAFETY ASSURED WITH C-PRESS METHODS

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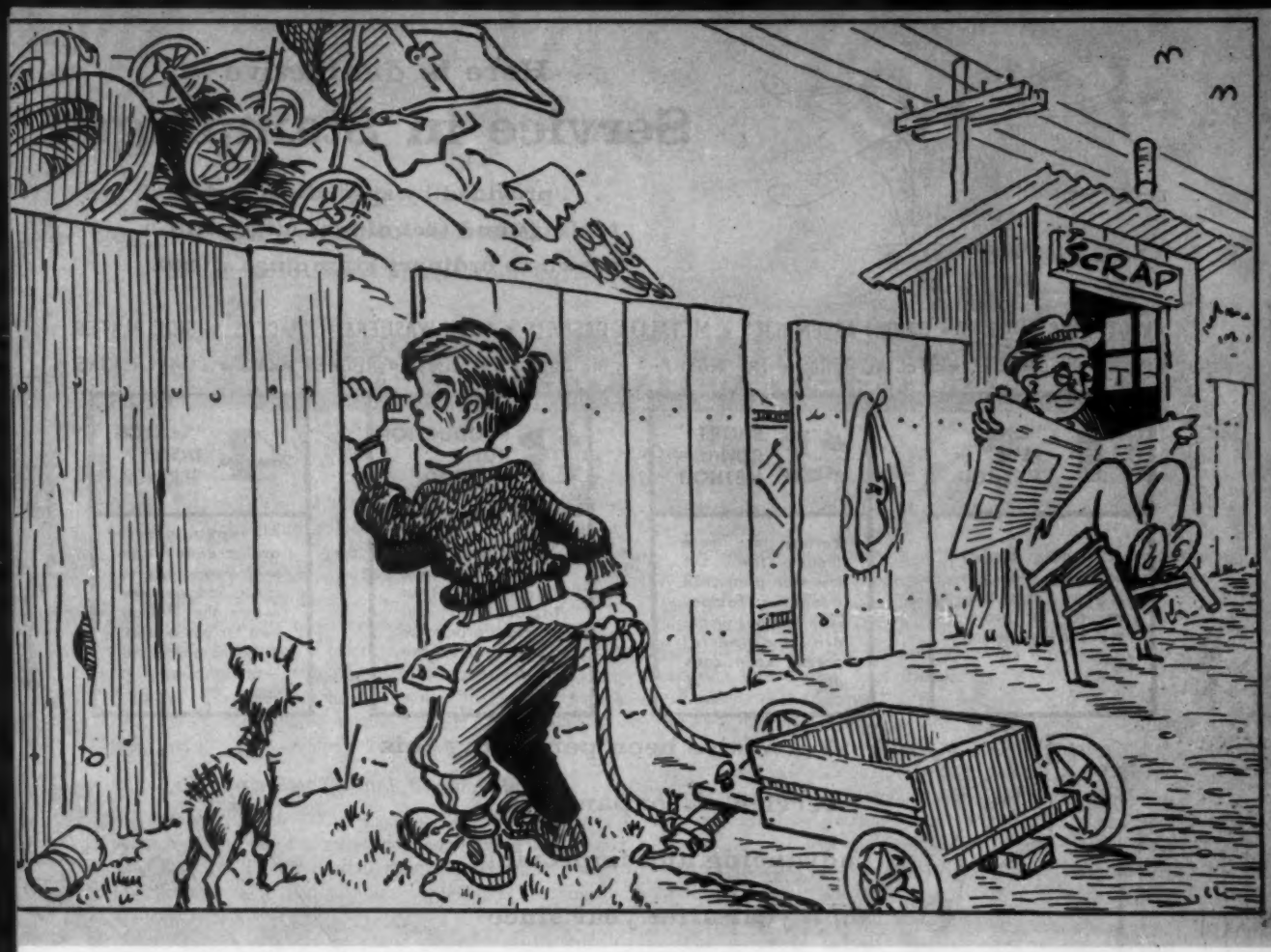

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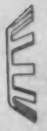

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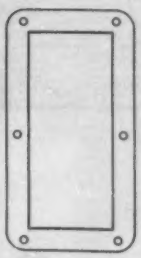
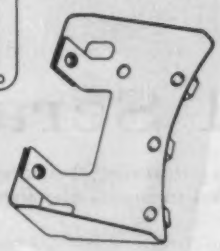
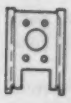

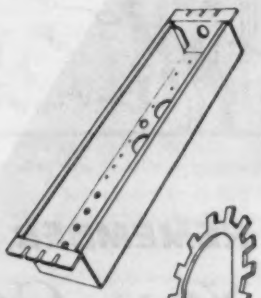

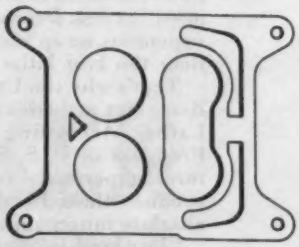

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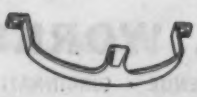

- **Schools Claim Surplus Tools**
- **Defense Tool Outlook Becomes Better**
- **Hearings to Probe Paper-Work Costs**

Keeping up with Washington

Loring F. Overman

APPROXIMATELY 7500 machine tools are being claimed yearly from government surplus by secondary schools and colleges under a program directed by the Metalworking Equipment Division, Business and Defense Services Administration. These machines, while considered obsolete or otherwise unsuited to government uses, are quite modern when compared with the type of equipment generally available to schools under existing budgets. The 7500 school-assigned tools are from a total of 25,000 declared surplus each year, BDSA spokesmen said.

Defense Tool Outlook Becomes Better

The Department of Defense, not a heavy buyer of machine tools in recent months, may again enter the market substantially. The perennial question of what tools to buy for making which weapons appears to be rounding another corner.

Yesteryear's shift from plane production to missiles dictated important changes in machining, including emphasis on micromachining of small parts. Today's trend includes some return to manned aircraft and to the machines that fashion them.

Hearings to Probe Paper-Work Costs

Defense contractors who have complained about the rising cost of paper work involved in military business transactions may have their day in court. Two Congressional Committees on the Armed Services will schedule hearings early in 1961. They will investigate the charge that paper work is assuming a steadily rising portion of contractor costs. These, passed along to the Government, become charges against the defense budget.

Part of the blame is being directed to the electronic brains, the wonder machines intended to simplify work and reduce costs at the government level. Contractors contend that the newer questionnaires seek information needed by the machines, but which is unavailable through ordinary bookkeeping methods. Some reports, business contends, can be provided only by engineers, chemists, research scientists, and other specialists.

Milling Machine Standardization Group

The National Machine Tool Builders' Association reports that the milling machine group may be the first to get into action under a new program to standardize general-purpose machine tool specifications. The program, assisted by the NMTBA but not an official function of that organization, includes formation of a joint coordinating committee of builder and user groups, including government representatives.

The milling machine people have suggested the names of two candidates for places on the committee—one a member of NMTBA and the other a nonmember manufacturer. Upon acceptance by the groups, the committeemen will meet to develop further plans for standardization of nomenclature and dimensions.

Government approval of the machine tool industry's progress toward standardization and interchangeability of machine tools, fixtures, and attachments is implied in the recent sixteenth semiannual report of the Defense Department's Cataloging and Standardization Program. The report observes that "this is the first such program of the machine tool industry and is designed to provide greater production, increased utility, and interchangeability of production tools in order to reduce production costs and shorten mobilization leadtime."

The scope of industry participation in the Defense Standardization program was enlarged, the report stated, by industry collaboration with the Department of Defense in the standardization of machine tools, materials-handling equipment, high-torque threaded fasteners, accessories for construction equipment, general-purpose bearings, electronic components, and drafting practices.

Industry "World Series" Starts

Machinery manufacturers will be well represented in the line-up of companies to be seen in action during the first three showings of a world series of official industry exhibits overseas.

In Damascus, United Arab Republic, the twenty-seven-day show which opened on August 15 was keyed to the theme of "Tradeways to Peace and Prosperity." Exhibitors were entered from twenty-five states, including a score of machine builders.

At Izmir, Turkey, a thirty-day show which opened on August 20 emphasized the theme, "Industry and Commerce Develop with the Port." More than forty animated, operating displays of machinery and equipment that spanned a wide range of subjects were entered.

At Kabul, Afghanistan, the Jeshyn International Fair was concerned primarily with "Small Industries and Irrigation."

These three shows will be followed by other trade fairs throughout the world during 1961. Inquiries from prospective exhibitors are invited by Walter S. Shafer, director of the Office of International Trade Fairs, Department of Commerce, Washington 25. D. C.

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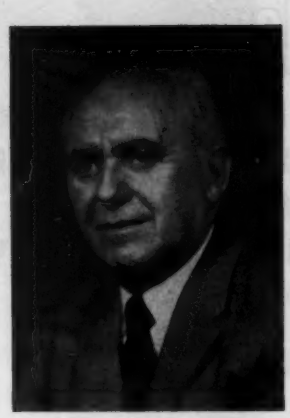

What an Education!

VISITORS to the machine tool and equipment expositions in Chicago last month were amazed at the advances in machine tools, particularly, since the shows of five years ago. The demonstrated progress in the development and application of tape-controlled equipment was truly phenomenal. Other machines based on completely new manufacturing techniques attracted much interest. Miniaturized machines garnered the attention of representatives of the electronic industry especially. Standard machines were on hand in considerable abundance and they, too, were designed for the ultimate in performance from the standpoints of production, accuracy, and convenience of operation.

Everywhere, management executives, production men, and designing engineers saw the latest types of equipment in actual operation. They could visualize the same equipment in their own shops solving their individual production problems or indicating means of doing their work more rapidly, at less cost, and with greater accuracy.

Therein lies the true value of industrial expositions of the type held in Chicago. The Machine Tool Exposition was a huge machine shop such as could not be seen anywhere else in the world. Every machine was the latest model of its kind, and the variety of equipment on display was so broad as to meet the needs of every branch of the metalworking industry and shops—large, medium, or small in size.

Manufacturing executives had the opportunity of learning about new techniques and bringing themselves up to date on the highly modern production equipment that is available today. Attendance at the Chicago expositions provided a chance to obtain an education on a new era of production methods. And what an education!

Charles O. Herb

EDITOR

New

RED RING MACHINE SHAVES LARGE GEARS FASTER . . . MORE EFFECTIVELY

Table in shaving position

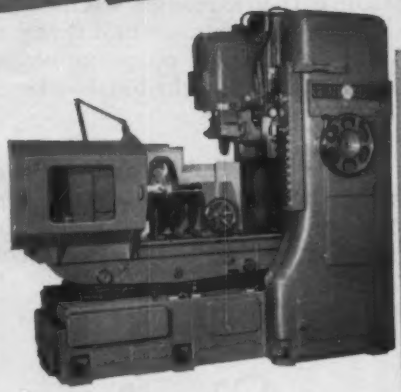

Table in loading position

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At the end of the shaving cycle, the cutter head rises in rapid traverse to clear the work and the table returns to its loading station for quick unloading.

If you manufacture such gears as are used in trucks, agricultural or ordnance equipment, ask for Bulletin S60-8 and get the full details of this new, economical method of gear shaving.

EXCLUSIVE RED RING ADVANTAGES

- Cutter above the work permits chips to fall away from and not into the cutter teeth.
- Thus positioned, the cutter is not vulnerable when the work is accidentally dropped while being loaded.
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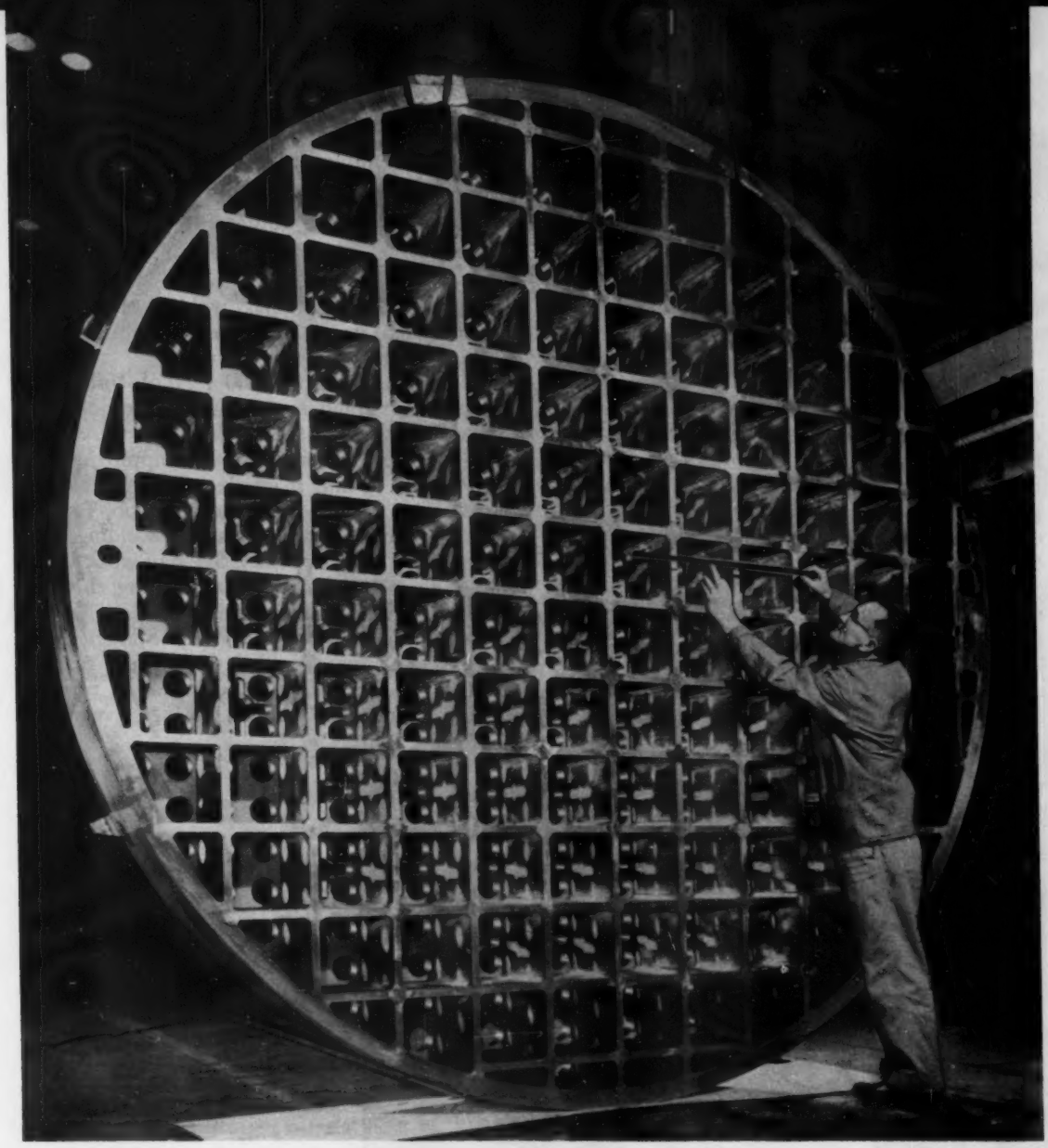


Nuclear Reactor Construction Depends on Precision Welding

Region Managers, Electric Welding C. R. ALLISON, Jr., Cleveland and J. LaFORCE, San Francisco
Linde Company, Division of Union Carbide Corporation

IN ITS FIRST major participation in the nuclear field, the Tapco Group of Thompson-Ramo-Wooldridge, Inc., Cleveland, Ohio, contracted to produce core structurals for an atomic reactor. A cost study comparing feasible welding methods showed Tapco that automatic submerged-arc welding would result in the high finished quality desired, and would be the fastest and most economical process in terms of time and labor requirements.

Fully automatic Unionmelt submerged-arc welding equipment was chosen, utilizing a pair of Linde UEH-2 heads installed on a Herrick traveling manipulator, with all controls in a console, Fig. 1. A test circuit designed into the unit enables the operator to first check out the com-

Atomic power reactors have not yet reached the stage of development where they roll off the production line like automobiles. But the latest units are beginning to show the use of modern fabricating methods as the effects of competitive cost become influential

plete sequence before starting to weld. The welding machine is designed for 100 per cent "start-to-stop" push-button operation, Fig. 2. An important part of the equipment is a six-channel Brush Development Co. instrument which records voltage, amperage, the two electrode-wire feed speeds, and the ram and roll speeds. Another feature—the two welding heads mounted opposite each other—enables a T-weld to be made on 3/8-inch plate, achieving 100 per cent penetration with no joint preparation.

The huge core components, which are the first ever to be submerged-arc welded, are 7 feet in diameter and may weigh from 3 to 13 tons. Thickness from 3/4 inch to 3 inches of SAE 304 and 347 stainless steel were welded with 1/8-inch Types 347 and 308 electrode wire at speeds up to 24 ipm. Multiple-pass welding of from five to twenty-two passes per weld was required, depending on thickness of the plate.

In the reactor's total 300 feet of Unionmelt welds, radiographic inspection revealed no cracking, slag entrapment, or other defects. Actual welding time for completion was approximately thirty hours. Using manual metal-arc welding, the alternate process for this type of job, Tapco's welding engineers had estimated a welding time of ten weeks on a two-shift, five-day week basis. With automatic submerged-arc welding, the production deadline was easily met.

For the Dresden Nuclear Power Station, General Electric Co. assembled the nuclear reactor core from basic building blocks called nuclear fuel-rod segments. Heliarc and Sigma welding

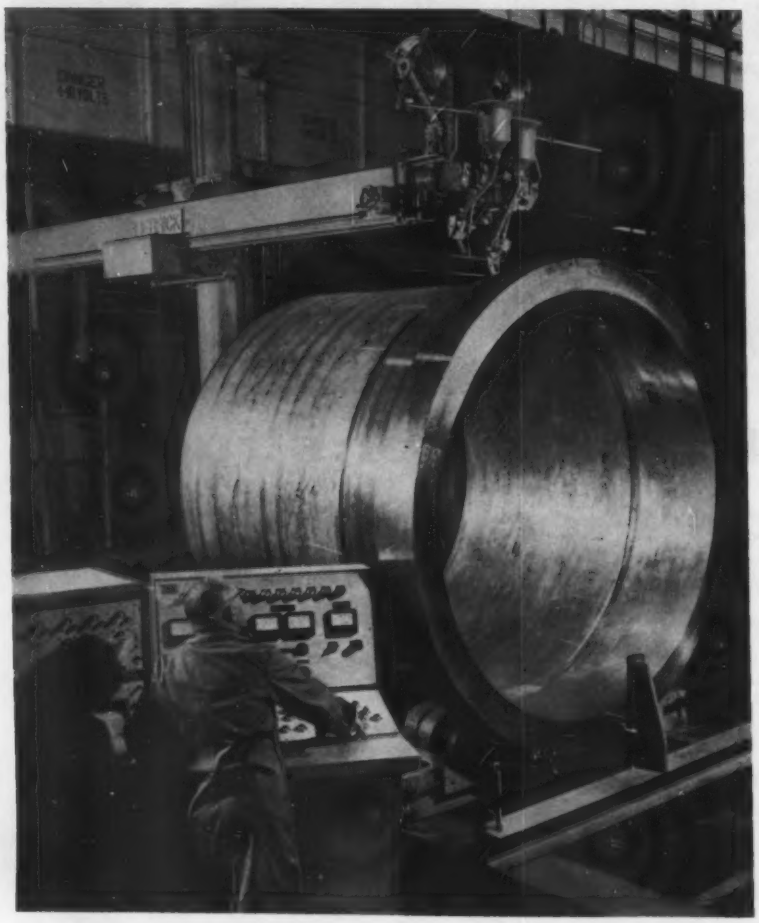


Fig. 1. Two UEH-2 heads perform multiple-pass, submerged-arc welding on the outside seam of reactor core. One man runs the entire operation from the console.

Fig. 2. Up to twenty-two passes were required to complete the inside welds on the reactor core. All Unionmelt welds had to pass strict AEC radiographic tests.

were important tools at every step of fabrication.

The segment is a simple tubular jacket of Zircaloy-2 zirconium alloy encasing a series of 1/2-by 1/2-inch uranium-dioxide pellets. The Zircaloy tube is 27 inches long with a 0.030-inch wall thickness. Threaded end plugs are attached by Heliarc welding under inert-atmosphere conditions to seal in the UO_2 pellets. Male and female threads are used at opposite ends of the rod, since four segments are coupled to form the 9 3/4-foot long reactor fuel rods.

Segments and end plugs are washed in detergent, rinsed and dried, and finally vapor degreased. Tube ends are then etched in a hydrofluoric-nitric acid solution, rinsed, and dried. The first plug end is next attached and Heliarc welded in an argon atmosphere at 76 to 78 amperes, direct current, straight polarity, using high-frequency arc starting to minimize cratering. The tube rotates in a positioner beneath the torch at a speed of 14 to 15 ipm, requiring eight seconds to complete a single weld. The welding is done inside a dry box, Fig. 3. The chamber resembles a huge iron lung and has equipment for vacuum and back-filling with either argon or helium. Copper chill blocks are used to reduce distortion.

With one end sealed off, the tube is filled with UO_2 pellets and the other end plug attached. This time a helium atmosphere is used with Heliarc welding, using 50 amperes at a welding speed of 24 ipm. The plug seam is completed in only five seconds. Batches of 100 to 150 segments can be welded before the dry-box welding chamber must be purged and recharged. The purity of the inert atmosphere within the chamber is extremely important, since Zircaloy-2 is easily corroded at welding temperatures, to the detriment of the joint and the assembly. The quality of the fuel elements greatly affects the reliability and, hence, the power output of the reactor. Economic power production must be maintained.

The fuel-rod segments are joined into fuel rods, four segments to a rod. Rods are next grouped into fuel assemblies consisting of six

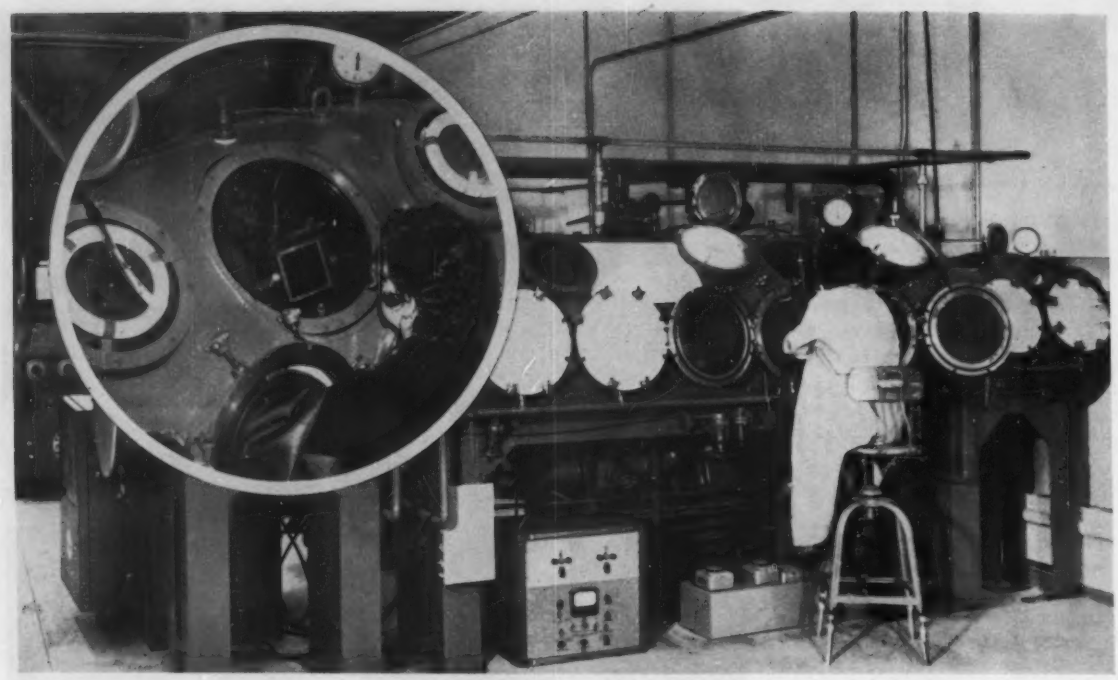


Fig. 3. Heliarc welding of Zircaloy-2 fuel-rod segment end closure in inert-atmosphere chamber. Inset shows inert-atmosphere welding with the operator working through the glove ports.

rows of six rods in a square pattern, Fig. 4. A square Zircaloy-2 channel encases the rods, with the resulting package called a bundle. This fuel bundle slides into a channel unit in the reactor core (488 bundles make up the completed fuel core). The channels are formed of two 1/16-inch thick, U-shaped halves of Zircaloy-2, Heliarc butt-welded longitudinally, Fig. 5.

To regulate the energy-producing reactivity of the nuclear core, eighty-eight control rods are spaced in the core between the fuel assemblies. These rods are austenitic stainless steel, normally 18 per cent chromium with 12 per cent nickel, and containing 2 per cent natural boron as the nuclear "poison" material. This is the element which absorbs the neutrons and controls the level of the chain reaction. The control rods move upwards in the core through cruciform guide tubes to decrease reactivity, Fig. 6. Moving the rods downwards increases reactivity, for increased power output. The 10-foot rods have an effective poison-section (dampening) length of 8 1/2

Fig. 4. Fuel-bundle assembly, consisting of thirty-six cylindrical fuel rods, is packed for shipment to Dresden station where it will be fitted into a Zircaloy-2 case.

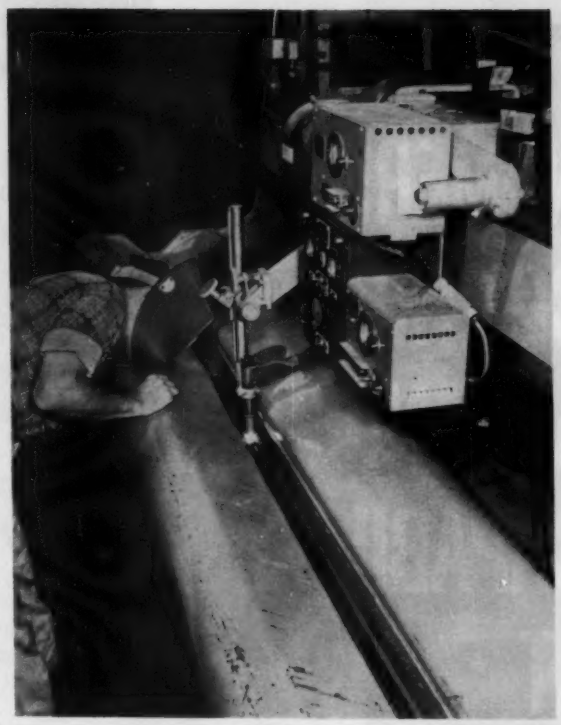


Fig. 5. Heliarc automatic welding, using a side-beam welding carriage, completes a longitudinal butt weld on a channel which positions the fuel bundle in an electric power plant reactor core.

feet. Tests at Argonne Laboratories limit the control rods to a three-year life span.

The control rods are 3/8-inch thick flat plates joined by a chain of intermittent weld beads 2 1/2 inches long on 6-inch centers. Sigma welding makes two "butter-pass" welds at each joint plus a bridging fillet, which reduces dilution and lessens fusion-line stress. Type E 312-16 stainless-steel wire electrode is used. All austenitic welds on the control rods are fluid-penetrant inspected. The guide tubes are formed by Heliarc welding two formed halves of 3/16-inch thick Type 304 stainless plate in a welding fixture.

Fuel bundles are carried vertically in the core by the bottom core-support plate. The latter rests on a ring girder that is supported by columns attached to the reactor-vessel bottom. An upper core-guide assembly holds the fuel-bundle assemblies in alignment at the top. The cylindrical support which acts as a thermal shield, also rests on the ring girder at the bottom and supports the upper core-guide assembly.

The core-support plate and guide assembly are Type 405 ferritic stainless steel—the former, 1-inch plate and the latter, 3/8-inch plate. They are joined into a grid type arrangement (heading illustration) by Sigma fillet welding. Type E 312-16 stainless-steel wire electrode is again used, and all ferritic welds are magnetic-particle inspected.

Fuel rods are leak-tested hydrostatically at 3800 psi. Then they are helium-tested for microcracks in the wall, radiographed, and checked for corrosion resistance in a steam autoclave at 1400 psi for seventy-two hours at 750 degrees.

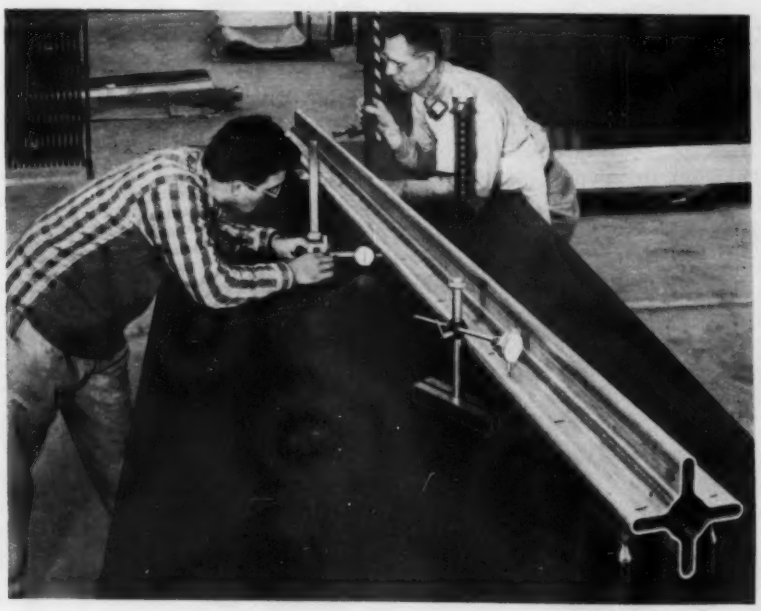


Fig. 6. Longitudinal butt-welding by Heliarc joined this zirconium alloy control-rod guide tube shown on the granite surface plate being checked for dimensions.

NUMERICAL CONTROL — ADVANCED CAPABILITY AT ROCKETDYNE

WILLIAM B. JOHNSON, Industrial Engineer, Chairman, Numerical Control Coordinating Committee
Rocketdyne, Division of North American Aviation, Inc., Canoga Park, Calif.

MANUFACTURING, engineering, quality control and plant engineering departments, as well as the management, have taken a positive viewpoint in favor of numerical control at Rocketdyne, Division of North American Aviation, Inc., Canoga Park, Calif. They recognize that the true role of numerical control must be an integrated program from the original design intent or concept of a part through machining and final inspection, utilizing numerical control as a tool through all design and manufacturing phases. To realize such a program, the following steps are taken:

1. In preliminary and advanced design stages, many possible rocket-engine design parameters are compared and evaluated so as to obtain optimum performance designs through computer programs.
2. Complete mathematical-analytical definitions that express the engineering design intent are obtained by computer programs, where necessary.
3. Mathematical-analytical definitions are utilized to produce engineering test programs by numerical control that are used to check out preliminary designs before the manufacturing phase. For example, two- and three-dimensional models are made for photoelastic stress analyses, and also models of thrust chambers for wind tunnel tests.
4. Engineering drawings are made in the best "language" for numerical control, and still at the same time they are suitable for conventional processes.
5. Necessary adjunct tooling is produced, such as master-milled templates, scribed loft boards, master-milled cams, and scribed optical comparators by numerical control, from the original engineering drawings by automatic computer programs and auto-

matic programs based on APT (Automatic Programmed Tooling).

6. Parts are made either directly by numerical control or by tooling produced through numerical control, in the manufacturing phase.
7. Parts are checked during manufacture, using inspection optical comparators, or master-milled inspection templates that were produced by numerical control.
8. Checking of parts is done on a numerically controlled measuring machine with printout data, or by applying another numerically controlled machine with an inspection part-path tape instead of the center-line cutter location tape.

Numerical Control—Used as a Research and Development Function

Rocketdyne's Canoga Park plant has the primary job of research, development, and testing of rocket engines. Numerical control was justified on research and development operations primarily on the basis of the need for flexibility in making prototype parts. There is the happy coincidence that the same tapes can also be used directly for production operations.

The present and future role in this fast-paced rocket engine industry is primarily dependent upon the research and development type of operation rather than on large production runs. This requires a flexible system that will enable the plant to quickly make engineering changes with the least possible cost and minimum use of tooling during the manufacturing phase. Only with such a system can stringent schedules be met and maintained.

A machine tool that provides such flexibility is the Burgmaster eight-spindle, numerically controlled drilling, boring, and tapping machine shown in the heading illustration. Estimates of the plant engineering department have shown that this machine more than paid for itself in tooling savings alone in one year of operation, not to mention other advantages. The machine has been operating around-the-clock and with every part produced on it both time and money have been saved.

Fig. 1. Ninety-six separate cuts are taken by a numerically controlled miller on a rocket-engine injector.

Fig. 2. Rocket-engine nozzle machined in just five weeks under control of Remington-Rand cards.

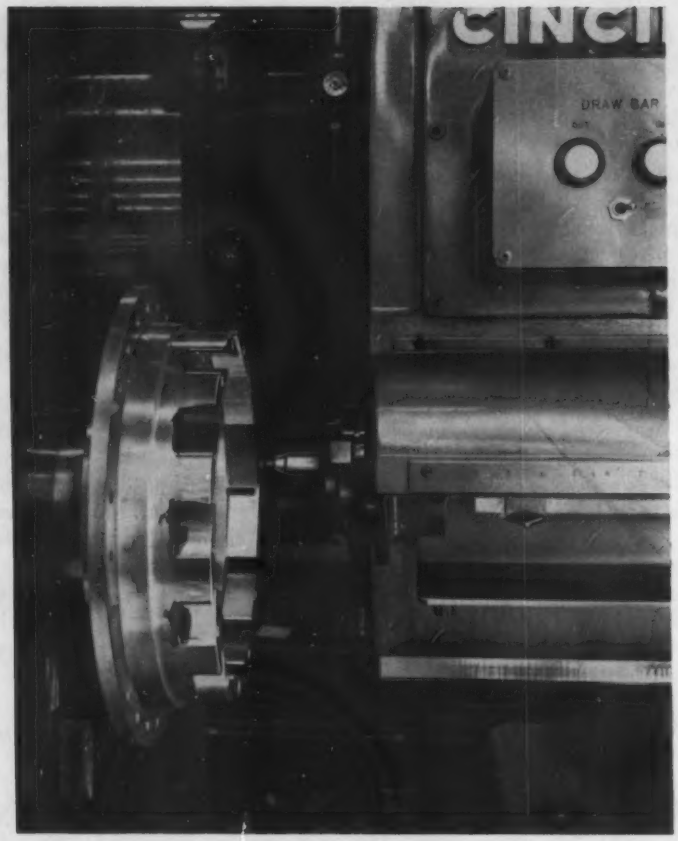


Fig. 3. Rocket-engine adapter machined under numerical control in six hours as against thirty hours by conventional practice.

Fig. 4. Tracer templates produced under numerical control by a Hydrotel milling machine.

Fig. 5. Tracer template in the process of being milled on a machine equipped with numerical control.

In several instances this equipment has made it possible to meet rocket-engine testing schedules that could not have been met with conventional machines. For example, on one occasion, a rocket-engine component was needed within four days to meet a testing program. The first two days were spent in making engineering changes. A tape was produced on the third day and a part was made on the fourth day, meeting the testing schedule. Had this part been produced by conventional means, an additional week would have been required. Engineering changes at the drawing board have been made on a part on a machine tool within fifteen minutes by simply giving the new engineering information on the punched paper tape.

Balanced Numerical Control Equipment Program

This flexibility has been implemented by the installation of well-rounded numerically controlled equipment. There is equipment for position-to-position drilling, boring, and tapping within plus or minus 0.001 inch; for position-to-position milling and boring within plus or minus 0.0001 inch; for three-axis milling within plus or minus 0.001 inch; and finally, inspecting within plus or minus 0.0001 inch. Thus, the capability of utilizing numerical control from the design intent through the final inspection of a part by numerical control is achieved. This upgrading of capability will be further enhanced in the future under a modernization and replacement machine program, which leans heavily toward numerical control.

Training for Numerical Control

In the earliest stages of Rocketdyne's numerical control program, the need was recognized for training employes in the principles of numerical control, particularly in the electronic and mechanical aspects. The first program started in the maintenance department, with the teaching of basic electronic and numerical control courses.

Fig. 6. Moore-Warner & Swasey measuring and inspecting machine which is tape-operated under numerical control.

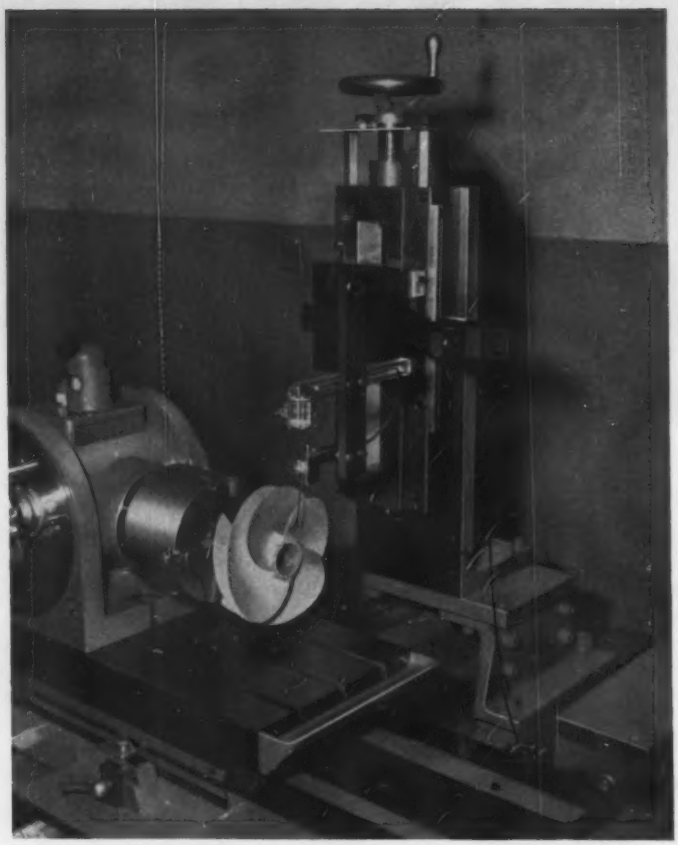


Fig. 7. Close-up view of the rocket-engine inducer being checked on the machine illustrated in Fig. 6.

Training on numerical control has since been extended to every affected department in the Rocketdyne plant.

Team Concept in Applying Numerical Control

The "Team Concept" is fostered in applying numerical control. At the initial layout and design stages of new work, designs are scrutinized for the feasibility of producing the part by numerical control. This is done by the production design analysis group in engineering. If there is the possibility of producing a part by numerical control, the preplanning and pretooling manufacturing processing control and numerical control parts programming representatives, with the engineering numerical analysis group, reach a decision together. Once the decision is made to produce a part under numerical control, every effort is made by the engineering numerical analysis group to help the design group by engineering computer programs, if necessary, to express the engineering design intent in the best possible language for use in numerical control, both for manufacture and inspection.

The manufacturing numerical control parts programming group makes the necessary planning, machining, and tooling decisions; develops layout manuscripts and computer input data; and produces the numerical control tape. Rocketdyne uses APT exclusively, utilizing 709 and 7090 IBM computers to produce the continuous-path controlled tape. The 709 computer is a large-scale and powerful vacuum tube machine, while the 7090 computer is a transistorized version of the 709 model. The tape is sent to the machine shop for producing the parts. Upon completion, the parts are inspected either by conventional methods or on a numerically controlled inspection machine.

Numerical Control Parts Programmers

Parts programmers and process planners responsible for numerical control machining are important factors in the success of the program. The planners must have a complete concept of numerical control principles so as to be able to make precise decisions relative to the machining of a rocket-engine part. They must possess a thorough knowledge of manufacturing methods, tooling, design, and the numerically controlled machines in the plant.

Numerical Control—Economics and Utilization

Many examples could be presented to emphasize the savings Rocketdyne has accomplished through the use of numerically controlled machines. Fig. 1 shows an operation in which ninety-six separate milling cuts were taken on the back of a large rocket-engine injector. These cuts were programmed for a Cincinnati three-axis machine. Programming required four hours and the total machining time was only three and one-half hours. Remington-Rand cards controlled the movement of the machine elements. The same operation required between thirty and forty hours per part when the machining was done by conventional means. These particular parts were machined in lots of three.

The heading illustration shows a rocket-engine thrust-chamber exit ring being machined under numerical control in thirteen hours. Previously, with the exit ring in jigs, it required approximately sixty hours to machine the part on a conventional drilling machine.

An experimental rocket-engine nozzle is seen in Fig. 2 being machined on a Cincinnati three-axis milling machine. The operation is also controlled through the use of Remington-Rand cards. Five weeks were required to machine this part from one of the so-called "exotic" metals even with this numerically controlled equipment. However, outside vendors would have required a minimum of eighteen weeks to make the nozzle on a conventional machine tool.

An integral-vane adapter for rocket engines is seen in Fig. 3 being milled on the same Cincinnati machine. The machining time was approximately six hours as against an estimated time of thirty hours that would have been required under conventional practice.

Tracer templates and tooling cams of many different styles are regularly produced on a numerically controlled Cincinnati Hydrotel milling machine. Remington-Rand cards are used to actuate the machine movements. A variety of such templates is illustrated in Fig. 4. They are made in one-half the time that would be required on a machine not provided with a numerical control. Fig. 5 shows a tooling cam being machined from a solid plate on the Hydrotel.

Numerically controlled inspection operations are performed on the Moore-Warner & Swasey measuring machine illustrated in Fig. 6, which provides a chart that gives all the desired inspection data. Fig. 7 shows a close-up view of the probing unit engaged in checking profiles of a rocket-engine inducer. The same equipment is seen in Fig. 8 inspecting and measuring an integral-vane rocket-engine adapter.

Numerical Control—Impact on Rocketdyne

Numerical control has affected all departments at Rocketdyne and will do so in the future to even a greater degree. It has effected tighter cooperation and coordination between engineering, quality control, manufacturing, plant engineering, and inspection departments. For numerical control to work well there must be constant coordination and cooperation between departments.

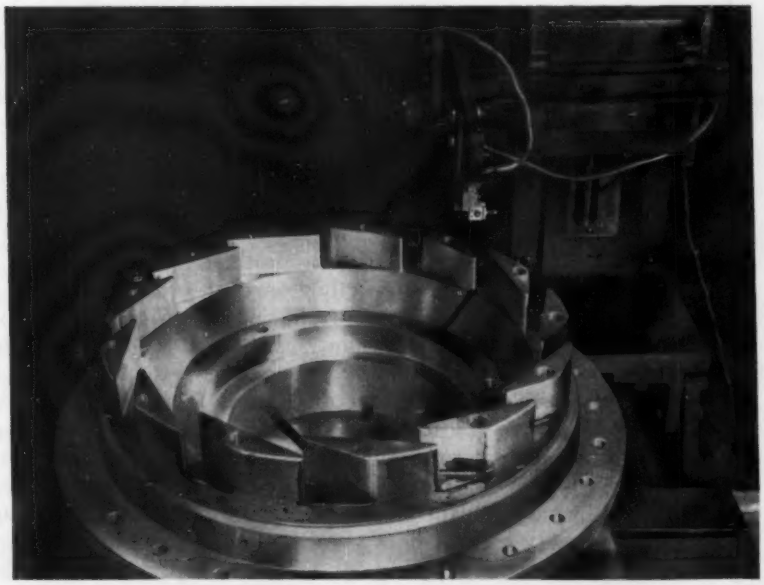
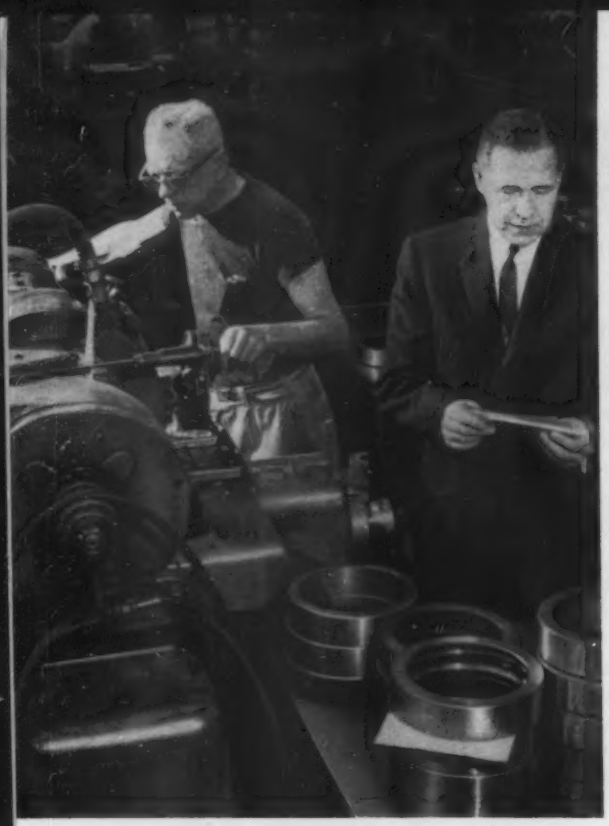


Fig. 8. Inspecting and measuring an integral-vane rocket-engine adapter on the Moore-Warner & Swasey machine.



Here is how one company is employing data processing to isolate the cause of defective parts and alert production personnel in time to prevent excessive losses. This system has also freed the quality control department to perform the staff functions of reviewing and improving the method. Results have been impressive

W. B. CLARK, Superintendent of Inspection and Quality Control
and
W. E. DONAVAN, Data Processing Supervisor
Norma-Hoffmann Bearings Corporation
Stamford, Conn.

USING DATA PROCESSING FOR QUALITY CONTROL

NO MATTER HOW GOOD gaging and inspection are, quality control will be effective only when the results are known in time to do something about them. To keep the manufacturing team—machine operators, foremen, and supervisors—informed of how well they are doing their jobs, Norma-Hoffmann Bearings Corporation, Stamford, Conn., is using an IBM data processing system to improve quality control. With this setup, corrective action can be taken in ample time because the results of inspections (Fig. 1) at fifteen centers are organized to determine the cause of quality control problems as they arise—not days and weeks later when losses from scrap and rework have reached costly proportions.

A data processing system of the type generally used to prepare payrolls and do other accounting tasks is employed. Since most of the more than 30,000 data processing systems now in use were installed for once-a-week or once-a-month jobs, there is generally no problem in scheduling the processing of quality control data on the same equipment. Besides making quality control information available in the factory where it can be used, data processing has cut clerical costs and has resulted in less rejects—a direct proof of the value of this approach.

Data processing has also affected the functions of the quality control department. By shifting responsibility for performance to factory personnel and those of other departments, the system has freed quality control personnel to perform staff functions, such as reviewing the performance of the system and planning improvements in it. In the heading illustration, data processing cards used in preparing quality control reports are being reviewed.

The measurable results of the quality control system at Norma-Hoffmann since it was installed two years ago have been considerable. Although during this period the company began manufacturing an increasing proportion of higher precision bearings, rejects were reduced 15 per cent. The reduction was greatest in the latter stages of manufacture. Fewer parts now go through costly operations after becoming defective.

Fig. 1. Inspectors at fifteen locations record the reason for rejections, lot quality, and machine and operator number. This enables the data processing department to summarize performance in reports that isolate causes of poor quality and lead to early correction.

Three Weekly Reports Keep Supervisors Informed

Foremen and production supervisors receive three weekly reports prepared by the data processing center. Special reports are also made by this department when required. The weekly reports cover quality performance of each machine, performance of each operator, and an analysis of rejects by each department.

The report on machine performance provides close control over setup operations and equipment maintenance and replacement. It has, for example, revealed the necessity to limit one automatic screw machine to work of smaller diameter than rated capacity, and to eventually have it rebuilt. In other cases it has prompted the company to replace machines ahead of the plant's modernization schedule.

The report on machine operators is used primarily for employe training and supervising purposes. It tells exactly how well each man is performing. Where there is a question as to the cause of rejects, comparisons of machine performance under various operators determine whether the machine or the operator is at fault.

Analysis of rejects by cause pinpoints quality problems more closely than any other method. For example, the production superintendent may discover, simply by studying the report, that a certain grinding machine has a tendency to drift over tolerances in grinding bores of outer bearing rings of more than 0.500 inch in diameter. Thus, the limitations of the machine are exactly determined by experience.

The cause of a problem is generally apparent in the three weekly reports. Where visual review and correlations fail to reveal the reason for an increasing trend in rejects, special reports are prepared. Action is thereby initiated before rejects actually become excessive. The available information may be analyzed in any form desired, and reports can be made to correlate any of the following factors: type, size, operator, machine, cause of rejection, quantity reworked, and quantity scrapped. A report can even be obtained on the performance of inspectors.

These quality control reports affect every aspect of the plant operation. One special report, for example, indicated that most rejects due to tight retainers were concentrated in certain types and sizes. As a result, the retainer design and assembly techniques were revised for these types and sizes.

Special reports also permit experiments with methods to improve quality. For example, a series of detailed reports analyzing rejects due to defective surface finishes on races, which are first ground and then lapped, enabled adjustment of the work between the two operations for optimum results in each type and size.

How the System Operates

Although extensive planning and co-ordination between the quality control and data processing

Fig. 2. Setting up data processing equipment for quality control operations is done only once. Machines are programmed by interchangeable circuit boards which are kept and used whenever a particular report is prepared.

departments were required to establish the system, its operation is relatively simple. Unlike many mechanization programs, it requires less managerial attention than the one previously employed. As each inspection center was added to the system, inspection personnel were shown how to make out the system input cards. After a few difficulties were worked out, operation became virtually automatic. Inspection centers report results to the data processing center on punch cards. From these cards, the processing center prepares weekly and special reports for production supervisors. The quality control department, which also receives copies of the reports, reviews performance of the system.

Little work is required in developing the information for these complete analyses. Inspectors report no more information than they did before data processing was used. The inspector simply fills out a punched card for each lot inspected, giving the date, production employe's clock number, quantity of parts scrapped, quantity tagged for rework, and cause of rejections. From the ticket accompanying the lot, the inspector also copies the data on size and type of part, the operation, operator, machine numbers, and lot quantity. Where inspection is made on a statistical sampling basis, rather than of all parts, the size of the sample is also entered.

Reporting and Processing Data

Only four different card forms are used: one for lots inspected by sampling, one for lots given 100 per cent inspection in the eight inspection centers in the machining area, and two (one for each of these inspection methods) for lots in the seven centers in the assembly area. The code for reasons for rejection is printed on the back of each card. There are seventy-four reasons for part rejection in machining area inspections and fifty-eight in assembly operations.

Three machines are used to process the cards into reports in the data processing center. The information is first punched on a key-punch machine. A card sorter then arranges the cards with regard to the type of report to be made—sorting them according to inspection center, operation, machine, operator, or other pertinent factors. In the final step, the cards are summarized and printed in an IBM tabulating machine.

Setting up the type of data processing equipment used at the company for the preparation of any particular quality control report is done only once. The machine is programmed by wiring a plug board (Fig. 2) to arrange the required data as desired. The board for a report is maintained and put on the machine whenever that particular report is required. Like other departments of the company, quality control is allotted a certain amount of time each week to use the data processing equipment.

Although the results have been gratifying, the company is constantly improving the system. With the installation of a computer with large storage capacity, which will also be employed for other purposes, the company hopes to make still greater use of information punched on the inspection cards. A computer will mechanize calculation of the percentage of each lot that is defective for each of the fifteen inspection centers. These figures are now calculated from the summaries made in data processing. Other uses are also expected to arise as the company gains experience in applying the quality control data thus acquired.

Fig. 1. Ceramic shell for investment molding makes practicable the casting of various parts shown compared to the 1-foot rule in the foreground. Even larger lost-wax castings are feasible.

Ceramic Shell Mold Boosts Investment Casting Weight to 100 Pounds

LAURENCE W. COLLINS, Jr., Associate Editor

A NEW MOLDING PROCESS involving the use of ceramic shells can produce intricately shaped investment castings weighing up to 100 pounds, Fig. 1. Castings made by this process are now on actual production in virtually all castable alloys, by plants of the Arwood Corporation, which has headquarters in New York City.

Previously investment castings made in solid molds were limited to a size easily held in the palm of the hand. But the new ceramic shell process, besides greatly increasing casting weight and size, offers many additional advantages: parts can have far more intricate coring (Figs. 2 and 3), shapes which cannot be made by any other method, a finer grain structure, and better and more consistent surface finish. Freedom in engineering the casting setup results in generally sounder castings, and much less finishing is required than with solid mold castings.

For the primary ceramic coating, the assembly molded wax pattern (Figs. 3 and 4) is dipped in the primary refractory ceramic frit and drained to obtain a thin, uniform skin (Fig. 5). While still wet, this is covered, or "stuccoed," with fine refractory grain. Then it is dried for 90 to 120 minutes in an area where temperature and humidity are constantly controlled.

The stuccoed pattern is dipped in a different ceramic frit, called backup, and drained to thin the coating. It is stuccoed again with a coarse refractory grain, and again dried in the controlled temperature-humidity area. The cycle is repeated until the required number of coats is in place to give the needed strength, then dried for approxi-

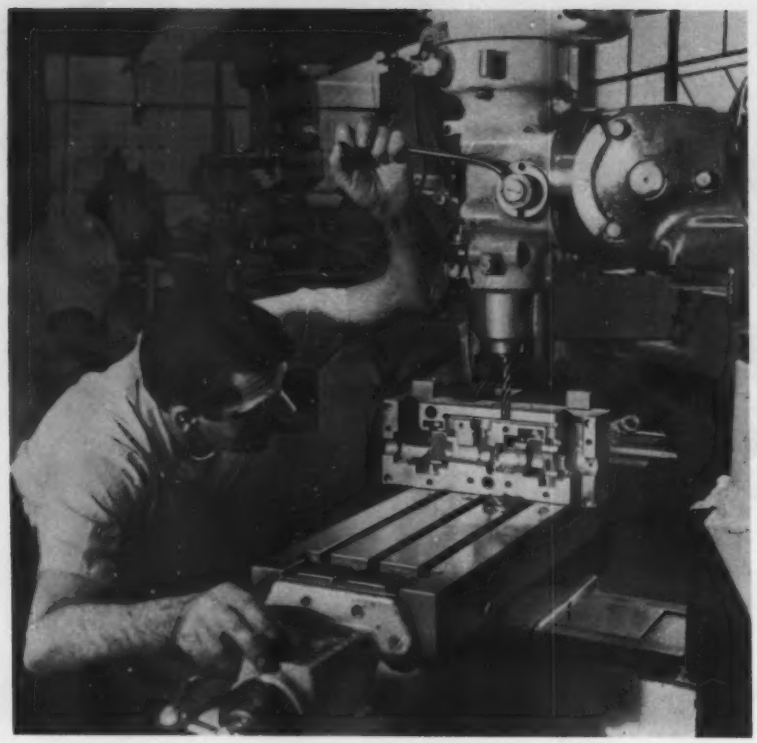


Fig. 2. A toolmaker in one of Arwood's plants puts the finishing touches on a die for a wax pattern.

mately twenty-four hours. Next it is flash-dewaxed at 1800 degrees F. and, after slow cooling, the shell is fired at 1600 degrees F. for thirty minutes. Casting with a new shell mold can be done directly from the firing oven, or the mold can be allowed to cool for shelf storage and reheated just prior to pouring. In either case, the shells are removed from the furnace and positioned for casting. The molds are cast using the contents of one or two 50-pound capacity ladles, Fig. 6.

The introduction of ceramic shell molding broadens the base of investment casting as a production process. Basically, solid mold investment casting consists of molding wax patterns in a die

Fig. 3. Special investment casting wax is injected into the finished die. Here an operator removes the wax pattern from a die.

Fig. 4. System of wax gates, sprues, and risers is wax-welded to the wax pattern.

(Figs. 3 and 4); placing the patterns in a flask; and surrounding, or "investing," them with a ceramic material. The wax is then melted out, leaving a cavity into which molten metal is poured.

The frozen mercury process uses mercury as the pattern material. Liquid mercury is poured into a die, which is then frozen. This frozen pattern is then invested with a ceramic coating in a solid mold flask and the mercury is melted out to leave the casting cavity.

Arwood's new ceramic shell technique fits right in between the solid mold and frozen mercury methods, filling what was a gap in the investment casting industry.

A shell type ceramic mold is made by building up successive monolithic ceramic layers around a wax or wax-and-plastic casting setup. The number of ceramic layers making up a shell mold will vary, depending upon the thickness required to withstand the casting pressures of the molten metal. In general, six layers are used to build up a thickness of approximately 1/4 inch.

Here is how it is done: a wax or plastic pattern is produced in a machined or cast injection die; one or more patterns are assembled, with runners, sprues and risers, into an acceptable casting setup. After cooling, the casting is cleaned, trimmed, heat-treated, and finished in the conventional manner.

The dependability of small investment casting has firmly entrenched the method in the jet-engine component industry where extremely intricate, precise designs are specified in stainless steel and nonferrous alloys that are difficult to machine. The requirement for weight saving combined with high strength is answered by investment castings which make, in one piece, parts that normally would require fasteners or welding of one sort or another. The availability of highly reliable investment castings in giant sizes and weights offers avenues for great economies in the design and construction of airframes and jet-engine components and accessories. Arwood's engineers anticipate that investment castings of over 100 pounds will be available as soon as demand justifies larger melting facilities.

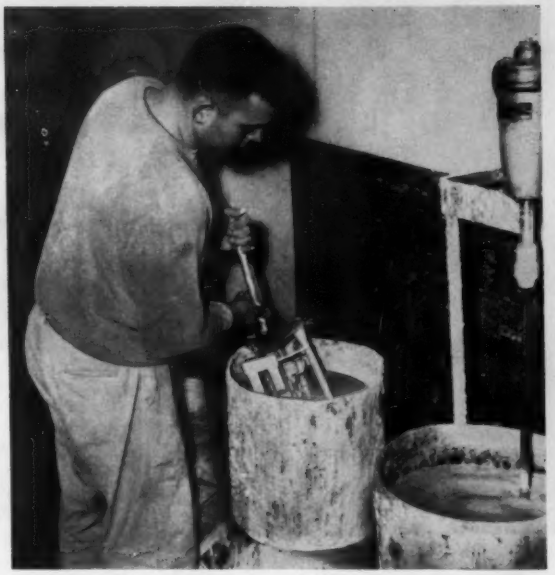


Fig. 5. The wax pattern is fixed to a handle and, for the first of several times, it is dunked in a slurry of ceramic frit. After draining, powdered ceramic will be dusted over the wet slip to help build the mold into a self-supporting monolithic structure.

Fig. 6. Casting the ceramic shell mold cavity follows the mold preheat. During the heating the wax mold melts and burns away, leaving the mold cavity.

PLANER BROACHES EXTRUSION DIES

FRED KELLNER, Carborundum Company

Fig. 1. Triangular aperture broached in this extrusion die has equal sides and identical corner radii.

The machine shop where the writer is foreman received a plant requisition to make a group of extrusion dies to produce a part with a triangular cross section. No broaching machine was available, so it was necessary to improvise one by tooling an open-side planer to do the job. The broaching cutter was made by one of the shop toolmakers.

Briefly, the die aperture, Fig. 1, had to have three identical straight sides and identical corner radii. A turret lathe was used to turn and face the blanks and drill a center hole through each. Then the blanks were inscribed on the top face with the required triangular layout. Next a vertical bandsaw was used to cut to about 0.015 inch inside the line on the legs and leave about 0.125 inch of stock in each corner radius.

The broaching tool was twenty-four inches long, with thirty-eight cutting teeth, and made from tool steel and hardened. The setup on the planer, Fig. 2, was rigged by taking the tool-slide off the saddle and substituting a backup plate to support the blank during broaching. Guide blocks were fastened to the planer table with their center lines aligned to the stroke of the table. One of the blocks (Fig. 2, right) was bolted tightly so that it acted as a firm headstock to pull the broach through the aperture of the die with the latter bucked by the backup plate. The other block, left, had an adjustable center, acting as an alignment guide for the broach. When the table was moved at slow speed to the right, the broach was drawn through the aperture, removing stock from the bore, and producing the internal profile.

The resulting dies were satisfactory in meeting expectations for uniform dimensional tolerances, and the improvised setup performed without noticeable difficulty.

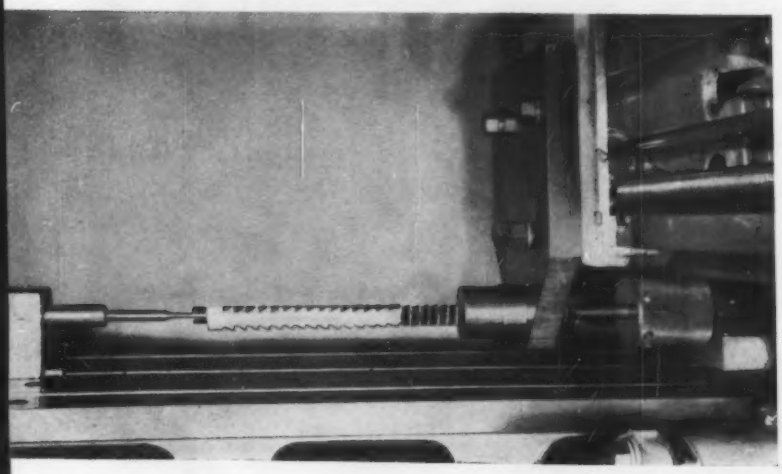


Fig. 2. Planer rigged for broaching the extrusion die, showing backup plate on the saddle, and the broach starting its cut.

Condensed Review of Some Recently Developed Materials

Arranged Alphabetically by Trade Names

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Building Panels	Alcoa Colorib Panels	These building components are available in seven baked-on colors and feature trapezoidal corrugations with a diamond-embossed finish for extra strength and appearance. The enamel finish applied over a bonderized coating will not chip, crack, peel, flake, or blister under normal use.	For use as building panels on residential, farm, and light mercantile structures.
Rust Preventive	Alconol 102-A	This compound dries to a very thin, hard, clear film which will not pick up dust, grit, and dirt, nor will it rub off during handling.	Applied by brush, spray, dip or roller. Metals treated include tools, machinery, gears, and hardware.
Low-Alloy Steel	Armco High Strength No. 5	This high-strength, low-alloy structural steel has corrosion resistance equivalent to copper-bearing mild steel. Fabrication in the as-rolled condition is limited to simple bending across the rolling direction and very light flanging and forming operations.	Uses include railroad-car frames, truck bodies, and related vehicles requiring high strength but only moderate corrosion resistance.
Metal Finish	Black Magic Zinc Black D	This nontoxic solution provides a glossy black finish on zinc plates and zinc-base die castings.	Used as an undercoat or bond for paints, enamels, or lacquers.
Soldering Flux	Blackstone Soldering and Tinning Fluxes	These fluxes do not leave a corrosive residue after soldering, do not have corrosive fumes, and possess a highly detergent cleaning action.	For use where its properties of noncorrosiveness as well as safety in preparation and use are required.
Antiseize Lubricants	Blue, Silver, and High Purity Goop	These compounds may be used in various temperature ranges and resist the effects of water washouts. They do not give off poisonous metal or oxide fumes at high temperatures.	Used to prevent seizing and galling of threaded parts and also as sealants.
Adhesive	Bondmaster M685	This two-part room-temperature-curing formulation is a free-flowing liquid. It is a 100-per cent solids, unfilled, modified epoxy adhesive.	For many bonding operations. At room temperature it develops 85 per cent of maximum strength in fourteen to twenty-four hours. It may be heat-cured in ten minutes.
Adhesive	Bond-Seal	A plastic adhesive which adheres to most metals but has a nonmetallic base. It is nonconductive and is not affected by corrosive chemicals.	Applications include watertight and oiltight repairs on metals and other materials.
Die Steel	BR-3 Die Steel	An abrasion- and wear-resistant cold-work die steel.	Used in shot-blast liners and for long-run blanking and forming dies.
Casting Filler	Copy-Cast	This two-component filler, sealer, and bonding agent has good adhesive qualities and dimensional stability.	Used for repairing blow holes, sand cracks, and broken areas in castings and tears, cuts, and dents in other metal parts.

For names and addresses of manufacturers of products listed, see end of this section

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Rubber Coating	**Coro-Gard 1706 Brand Protective Coating**	This general-purpose, one-part neoprene-rubber-based coating exhibits high adhesion to unprimed steel, aluminum, and other materials and has good resistance to the corrosive action of chemicals.	Used for protecting walls, steelwork, tanks, and machinery against industrial atmospheres, acids, and vapors; and for protecting materials-handling equipment against abrasion.
Die Steel	**Darwin No. 1 FM**	This high-carbon, high-chromium Type D2 air-hardening, free-machining die steel exhibits high resistance to edge wear and chipping.	Uses include blanking, drawing, forming, coining, and trimming and piercing dies; shear blades; compacting dies and punches; gages; and thread-rolling dies.
Lock-Nuts	**Delrin Lock-Nuts**	These lock-nuts have good strength, rigidity, dimensional stability, and resistance to water and organic chemicals. They are nontoxic and odorless, lightweight, abrasion-resistant, and smooth to the touch.	When assembled they form their own threads and are used for light-duty applications where corrosion resistance and reusable locking action are desirable.
Epoxies	**Devcon 100 Devcon 101**	Two epoxy tooling and repair compounds that have good tensile and compressive strength, resist most chemicals and oils, and will adhere to all types of metals, woods, ceramics, and other materials.	For repairing damaged machinery, foundry patterns, and core boxes. They have also been used for making patterns, dies, core boxes, holding fixtures, and other tools.
Adhesive Film	**Double-Face**	A two-sided, translucent, pressure-sensitive mass in film form, supported by a protective release paper. Its adhesive properties are not affected by coolants.	Used as a means of holding nonferrous metals on magnetic chucks for surface grinding operations.
Grinding Wheel Coolant	**Dri-Kool**	A treatment for grinding wheels that retards loading and functions as a dry coolant.	For burr-free, burn-free dry grinding of high-speed steels.
Aluminum-Silicon Bronze	**Duronze 708**	In the annealed temper, this material has a tensile strength of 85,000 psi, a yield strength of 40,000 psi, and an elongation of 30 percent in 2 inches. It has good corrosion, wear, and fatigue resistance.	It is suitable for making valve parts for installations involving low temperatures, such as handling liquid air, oxygen, and hydrogen.
Adhesive	**EC-1390**	This high-strength, oil-resistant elastomeric-base adhesive produces bonds which have high softening points and resist plastic flow. The wood-to-steel bonds have shear strengths in the range of 400 psi.	Used for laminating plastics and metals, and joining other material such as honeycomb cores in sandwich-panel construction and insulation material to metal.
Stripping Agent	**Epoxystrip No. NC-194 (noncorrosive)**	A stripping fluid that quickly attacks and removes difficult finishes without harmful corrosive effect to the metal underneath. It will not corrode magnesium, steel, aluminum, brass, or any combination of these metals.	For removing tough modern finishes such as epoxies, polyurethanes, and new acrylics, as well as the conventional paints, lacquers, and enamels.
Dry Lubricant	**EverLube 811**	This dry lubricant is completely inorganic, nonflammable, nontoxic, and does not require extreme temperature cure.	Used in a temperature range of from −300 to +1000 degrees F. at loads up to 50,000 psi.
Coating	**Farboil Epothanes**	Resists attacks of corrosion, erosion, abrasion, solvents, and chemicals	For protecting all floors, equipment, tanks, and pipelines against chemical solvents, abrasion, and impact.
Thread Compound	**Fel-Pro C5-A**	This antiseize thread compound has good lubricating and sealing qualities, low breaking and running torque, and is nonsettling, and nonhardening.	Used to lubricate and seal bolts, studs, flanges, etc., at high pressures and high temperatures (up to 1800 degrees F.).

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Titanium Carbide	Ferro-Tic S-45 Ferro-Tic S-55	Both have the machinability and heat and corrosion resistance of stainless steel. The S-45 has a hardness of 45 Rockwell C and the S-55, a hardness of 55 Rockwell C. Both may be ground, welded, or brazed.	Used for valves or valve seats, seals for pumps, nozzles, gages, bearings, and forming tools.
Hard-Facing Tube Rods	Haynes 90, 94, and 4560; Nickel-Manganese, Hascrome, and Haystellite Tube Rods	The tube rods contain an internal flux to make open-arc deposition possible and insure a sound slag-free deposit. The copper coating on the rod helps prevent rusting, makes feeding easier, and provides better electrical contact through the welding head.	Available in coils for semi-automatic open-arc hard facing.
Hydraulic Conditioner	Hydra-Gard	A specially formulated product for use in hydraulic power equipment to stop sticking in hydraulic valve systems due to varnish-like deposits and friction.	Recommended for use in road machinery, high lifts, printing machinery and other hydraulic power equipment.
Paint Primer	Jet-Dri Multi Surface Rust Inhibiting Primer	A primer which produces a hard impact-resistant finish that resists most acids, alkalies, alcohol, and boiling water.	Applicable to any iron and steel parts. The inhibitor stops any rusting on contact.
Tantalum Sheet	Kawecki Tantalum Sheet	This nonwelded tantalum, available in a 36-by 72-inch size, is chemically inert to all common mineral acids.	Primarily for use in the construction of chemical-reaction tanks. May also be used in heating equipment.
Metal Cleaner	Kelite Spray Cleaner No. 5-S	An alkaline cleaner which is low-foaming and has good soil-removal properties. It is a stable, free-flowing dustless powder that is readily soluble in water.	For removal of rust-preventive oils and many soils from ferrous-metal stock or components.
Carbide	Kennametal Grade K165	A steel-cutting grade of hard carbides available as throw-away inserts for all types of Kendex tooling. It has a titanium-carbide base and has good edge-wear and crater resistance.	For high-speed and high-precision machining and for finish-machining hard alloys.
Rust Solvent	KPO No. 1	This product has a wetting power which enables it to penetrate deeply and quickly into rust-frozen surfaces it also provides lubricating properties to parts being disengaged.	Used for separating nuts and bolts, and flanges, couplings, pulleys, and wheels from shafts.
Shielding Metal	Mallory 3000	This high-density metal, which can be cold-worked and formed, exhibits an ultimate tensile strength of 195,000 psi, a yield strength of 190,000 psi, and a proportional limit of 90,000 psi when rolled to a 52-per cent reduction in thickness.	Applications include high-density weights, counterweights, and radiation shielding. Special designs may be fabricated by utilizing brazing and sinter welding.
Epoxies	Maraset Laminating Resin No. 607-AA and Maraset Brilliant White Gel Coat No. 606	Two nonirritant epoxy laminating systems. The 607 formulation has properties which include low shrinkage, dimensional stability, and good chemical resistance. Both materials with their hardeners are nonfuming, relatively odorless, and readily mixable into an air-bubbleless blend.	The 607 formulation is used in combination with glass fibers for sturdy reinforced plastic tools and parts. The 606 formulation is useful as a surface coating for molds or models where glass fiber pattern or texture should not show through.
Aluminum Polish	Met-All	The polish is harmless to the skin, nontoxic, nonflammable, and easy to apply.	For cleaning and polishing aluminum to a mirror-like finish. It also treats other nonferrous metals.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Abrasive	**Metallite Type 101**	The abrasive cuts fast, keeps work cool, and keeps shedding to a minimum.	Available on fiber discs and cloth belts for all grinding operations.
Coating Agent	**Microthene Polyethylene**	This finely divided powdered polyethylene is available as a low-density, high-melt-index material and also as an intermediate-density, medium-melt-index material.	Metal parts can be coated using dry powder or dispersions for their protection against corrosion.
Coated Steel Strip	**Miracoil**	This highly decorative, abrasion-resistant, plastic-coated strip steel is unaffected by most acids, chemicals, oxygen, and industrial fumes. It may be subjected to the same end-product forming operations as uncoated steel.	Uses include the manufacturing of home appliances, furniture, electronic equipment, and many other items.
Brazings Alloys	**Nicrobraz Standard-W, 30-W, 50-W, 60-W, 130-W, 150-W, and LM-W**	These self-flexing materials insure optimum wetting and flow because of their vaporizing flux constituents. They do not attack the base metal and leave no residue.	Applications include brazing of difficult alloys (such as aluminum and titanium bearing metals) in hydrogen and argon atmospheres.
Nickel-Silicon Bronze	**Nironze 635**	This alloy has a tensile strength of from 38,000 to 100,000 psi, a yield strength (0.2 per cent offset) of from 10,000 to 85,000 psi, and a hardness of from 7 to 95 on the Rockwell B scale—depending on the condition of the material.	Used for fasteners, swivel joints, marine hardware, switch gear, and wire connectors.
Cutting Oil	**No-Gall Cutting Compound**	A compounded cutting oil for difficult or critical machining operations.	Extremely effective in preventing galling of both cutting tools and work-pieces in such difficult operations as broaching, tapping, and threading.
Pressure Hose	**Nylaflow Pressure Hose**	A hose with a specially formulated nylon inner tube reinforced with a high-tensile-strength yarn. It has an abrasion-resistant cover and exhibits resistance to flex, pressure-pulse, and vibrational fatigue.	For applications such as hydraulic, lubrication, fuel and oil, hot paint, solvent, water, Freon, and high-pressure pneumatic and CO_2 lines.
Adhesive System	**PA-746**	An adhesive system for bonding "nonbondable" Teflon to itself and to other materials.	May be used on any standard grade of Teflon or any other fluorocarbon plastic.
Lubricant	**Pennzoil Special Multi-Purpose Lubricant**	This multiple-purpose lubricant is a high-melt-point, lithium-base grease.	For providing rustproof security and good adhesion to metal under all weather and operating conditions as it lubricates.
Pipe	**Pfaudler F-C Glasteel Pipe**	A glass-lined steel pipe that can be field-cut to required length. It is both corrosion and abrasion resistant.	It offers wide application in highly corrosive services, and is also ideal for those applications where freedom from product contamination or adhesion is required.
Tungsten Coatings	**Plasmarc**	These coatings are applied directly to the base metal or on top of undercoatings for protecting solid-propellant graphite rocket nozzles.	To provide protection from high temperatures and pressures in exhaust gases and hold throat erosion to an acceptable minimum when high-aluminized propellants are used.
Pipe-Joint Sealant	**Plastic Lead Seal**	The compound prevents seizing and galling and can be used at temperatures up to 500 degrees F. and pressures up to 6000 psi.	Used as an industrial pipe-joint and thread-sealing compound. It remains permanently plastic.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Nylon Shapes	Polypenco Nylon	Nylon sections weighing up to 400 pounds and measuring 36 inches in width, 2 5/8 inches in thickness, and 102 inches in length are available.	For such applications as tooling fixtures, wear plates, large rollers, etc., where corrosion resistance and resilience are desired.
Structural and Die Steel	Potomac A	This steel combines good ductility along with a high yield strength to weigh ratio in a temperature range of from 400 to 1000 degrees F. It is an AISI Type H-11 steel.	For tool and die applications requiring strength at elevated temperatures, and also as a structural material for high-speed aircraft and missiles.
Dry-Film Lubricant	Poxylube	A formulation of molybdenum disulfide that exhibits good lubricity and adhesion. Surface preparation consists of simple degreasing.	Applied by spraying, brushing, or dipping, it provides permanent lubrication on all types of rotating and sliding bearing surfaces.
Stripper	Quick Strip No. 5	A nonflammable, alkaline, organic solvent type paint stripper which provides nominal rust protection prior to painting.	For stripping a variety of paint coatings and many epoxy-resin type coatings.
Releasing Agent	Release-Cote	The material is brushed on unpainted metal surfaces to restrict the adhesion of paint. It may be peeled off treated sections, leaving surfaces clean and unmarked.	Its use provides a significant reduction in after-painting cleanup of machinery and other industrial equipment.
Heat-Resistant Sheeting	Resin-Bonded Quartz Sheet	It is a combination of reinforced plastics and ceramics with high heat-resistant properties.	Should find use as an ablation-resistant material in the rocket and missile field.
Shim Stock	Roblinger P.M.C. Stainless-Steel Shim Stock	Made from Type 302 stainless steel, rolled full hard-spring temper, it is available in sizes from 0.002- through 0.010-inch thickness. Length of material in box is calibrated in ascending and descending order to allow user to cut proper length and inform him of amount left.	For shimming of jigs, tools, fixtures, patterns, and machinery as well as stampings, washers, and electronic parts.
Hydraulic Tubing	Ryerson Hydraulic Tubing	This cold-drawn, welded hydraulic-fluid-line tubing bends and flares easily and uniformly. It has a coating of oil on both surfaces.	This tubing meets or exceeds hydraulic standard specifications of JIC and is used for many hydraulic-fluid-line applications.
Dusting Cloth	Scotch Brand Dusting Fabric No. 550	This nonwoven, scratch-free fabric is made of extra-long rayon fibers bound together with a synthetic, odorless unifying resin which does not leave any sticky or oily deposit on dusted surfaces.	For dusting precision instruments. May be used on more than one piece without losing its effectiveness.
Electrical Tape	Scotch Brand Electrical Tape Nos. X-1111 and X-1112	The X-1111 tape has an extruded Teflon backing coated on one side with a pressure-sensitive adhesive which resists effects of jet fuels and hydraulic fluids and has good heat resistance. The other, X-1112, has a Teflon-impregnated glass-cloth backing which is coated with a thermosetting silicone adhesive.	The X-1111 is used at temperatures up to 155 degrees C. The X-1112 provides strength and holding power to perform heavy-duty functions while giving good cut-through resistance. Used at temperatures up to 180 degrees C.
Tantalum Tubing	Seamless Tantalum Tubing	The tubing is virtually unaffected by highly corrosive acids of all kinds.	It is used in the production of heat exchangers and acid concentration equipment.
Spring Material	17-7 PH Spring Wire	This stable flat form of precipitation-hardening stainless-steel spring wire has a modulus of elasticity of 29,500,000 psi in tension and 11,000,000 psi in torsion.	Applications include hair-clip springs, electrical-timer springs, and sprinkler assembly clips.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Metal Coating	**Skalix**	A coating which prevents scale formation on metal during heat-treatment. It is applied by spraying or dipping, and adheres to the metal at furnace temperatures, forming an oxygen-tight seal.	Applications include use on stainless steel, nickel-chromium alloys, cobalt alloys, and many new superalloys.
Corrosion Preventive	**Sprayon No 604 Antirust Spray**	Applied as a finely dispersed mist which penetrates into joints and crevices. The aeosol displaces moisture already present, forming a very thin waxy film that clings tightly.	Developed to protect parts between machining operations or in storage. It is also used on instruments, tools, etc.
Layout Fluid	**Sprayon No. 603 Blue Layout Spray**	Provides a smooth, dark, nonglare coating that dries instantly and will not rub off.	Used for the layout of fine lines on high-precision work.
Metal Powder	**Staimet**	This stainless-steel powder is not prealloyed. It can be used to produce structural shapes which exceed 95 per cent of theoretical density. It has excellent green strength and, in addition, relatively low compacting pressures are required.	Used to produce corrosion-resistant machine components such as gears, bushings, and valves.
Tubing	**Standard Tubing**	A great variety of special cross-sectional shapes are available in a broad range of sizes.	This carbon; low-alloy, high-strength; and stainless-steel tubing is used for pressure, mechanical, heat-resisting, ornamental, and atomic applications.
Nickel-Plating Process	**Superlume**	The process has the ability to level scratches to an extraordinary degree. It is simple to control and easy to operate.	For producing bright-nickel plating at both high and low current densities.
Brazing Alloy	**Superweld Brazing Alloy**	A high-temperature, controlled-atmosphere brazing alloy composed of copper, nickel, and boron.	Useful in progressive step brazing techniques which facilitate the prefabrication of brazed components and the subsequent assembly into a composite unit by furnace brazing methods.
Preclad Alloy	**Texas Instruments Preclad Alloy**	Numerous composites of silver or noble-metal solder alloys clad to base or precious metals are now available in sheet, strip, and foil form.	Use of these preclad alloys eliminates much separate fabrication and handling required by conventional brazing methods.
Temperature Indicator	**Thermomelt**	A precision temperature indicator available in stick, pellet, and liquid form.	Usable in a temperature range of from 113 to 2000 degrees F.
Pipe Joint Sealer	**Thred-Tape**	This tape withstands thousands of pounds of pressure, temperatures of from —250 to +500 degrees F., and can be used on all types of piping.	Used by wrapping around the male thread before making a joint, it has proved effective for handling acids, caustics, gases, etc.
Titanium Carbide	**Titanium-Carbide Tool Bits**	This material exhibits a dense and very fine-grained structure that is composed of a uniform dispersion of titanium carbide in a metal binder of nickel and molybdenum.	The steel-cutting grades are used for semifinish and finish machining and have a hardness range of from 90 to 93 Rockwell A.
Alumina Tubes	**Triangle R**	These pure porous Alumina tubes can withstand heat at temperatures up to 3540 degrees F.	Recommended for use in platinum, molybdenum, and tungsten wound heating elements for melting and heat-treatment processes.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Phosphating Compound	Turcoat Low Temp	This compound provides a uniformly smooth coating of up to 200 milligrams per square foot in two minutes at 95 degrees F.	May be applied by immersion or by means of a spray washer. It may be used as a bond for paint or as a base for corrosion prevention.
Barrel-Finishing Material	Type Q Medium	This pink quartz material is processed into shapes predominantly cubical, which tends to reduce the problem of lodgement when intricately shaped parts are being finished.	Available in a full range of sizes from 00 to 6. Its smoothness of surface permits its use in burnishing.
Titanium Sheet	Type RS-140	A heat-treated titanium-sheet alloy which is available in lightweight thin gages. Its tensile strength is in excess of 190,000 psi.	Applications include skins, stiffeners, internal structures, engine nacelles, bulkheads, and heat shields for aircraft and missiles.
Pipe Insulation	Unarco U-200	This nontoxic, nonirritating product has a K factor of 0.14 at 70 degrees F., a density of 2.3 pounds per cubic foot, and is not affected by most mastics and sealers.	This lightweight, rigid, urethane-foam pipe insulation is designed for use at temperatures ranging from −300 to +220 degrees F.
Steel	Unimach UCX2	A modification of AISI 4100 series type steel that exhibits yield strength levels of 225,000 to 235,000 psi and, when properly tempered, shows no susceptibility to notch sensitivity. It has good forming characteristics and good weldability.	Developed specifically for high performance rocket-motor cases for missiles.
Alloy Steel	USS STRUX	A high-strength alloy steel that can be forged, machined, and heat-treated to develop a tensile strength in the 280,000- to 300,000-psi range.	Applications include aircraft and missile parts such as landing gear components.
Carburizing Steel	Vac-Arc AGT (SAE 9310) Steel	This steel has a tensile strength ranging from 155,000 to 185,000 psi, a yield strength of from 130,000 to 162,000 psi, and an elongation in 2 inches of 15 to 16 per cent.	Along with its other properties, its high hardenability, high core hardness, and high fatigue strength make it ideal for jet aircraft engine parts.
Brazing Alloys	Wide Gap Alloys, General Purpose Alloys, and Honeycomb Brazing Alloys	These three types of vacuum-melted brazing alloys are "clean"—essentially free from inclusions, undesirable impurities, oxides, and absorbed gases.	Use of these materials is said to include many applications where welding is now used. Also used for brazing thin core materials.
Silicone Greases	XS-4006 SS-4005	Both greases offer good dielectric properties as well as good water repellancy and oxidation resistance. They will withstand temperature extremes.	The 4006 formulation is good for use around copper wire and splices. The 4005 formulation is useful for aircraft, automotive, and electronic industry applications.

NAMES AND ADDRESSES OF MANUFACTURERS OF PRODUCTS LISTED

Alcoa Colorib Panels—Aluminum Company of America, 722 Alcoa Bldg., Pittsburgh 19, Pa.

Alconol 102-A—Al-Con Chemical Co., Box 8168, New Orleans 22, Pa.

Armco High Strength No. 5—Armco Steel Corp., Middletown, Ohio

Black Magic Zinc Black D—Mitchell-Bradford Chemical Co., Milford, Conn.

Blackstone Soldering, Tinning Fluxes—Blackstone Corpn., Jamestown, N. Y.

Blue, Silver, and High Purity Coop—Crawford Fitting Co., 884 E. 140 St., Cleveland 10, Ohio

Names and Addresses of Manufacturers of Products Listed

Bondmaster M685—Rubber & Asbestos Corpn., 225 Belleville Ave., Bloomfield, N. J.

Bond-Seal—Beetle Plastics of Crompton & Knowles, Fall River, Mass.

BR-3 Die Steel—Latrobe Steel Co., Latrobe, Pa.

Copy-Cast—Future Chemicals, 3008 W. Montrose Ave., Chicago 18, Ill.

Coro-Gard 1706 Brand Protective Coating—Adhesives, Coatings & Sealers Division, Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.

Darwin No. 1 FM—Darwin & Milner, Inc., 2222 Lakeside Ave., Cleveland 14, Ohio

Delrin Lock-Nuts—Russell, Burdsall & Ward Bolt and Nut Co., 100 Midland Ave., Port Chester, N. Y.

Devcon 100 and 101—Devcon Corpn., Danvers, Mass.

Double-Face—Finishes Division, Interchemical Corpn., 120 Potter St., Cambridge 42, Mass.

Dri-Kool—King Graphite Products, Inc., 21950 Telegraph Road, Trenton, Mich.

Duronze 708—Bridgeport Brass Co., Bridgeport, Conn.

EC-1390—Adhesives, Coatings & Sealers Division, Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.

Epoxystrip No. NC-194 (noncorrosive)—Beck Equipment Co., 3350 W. 137 St., Cleveland 11, Ohio

EverLube 811—EverLube Corpn., 6940 Farmdale Ave., North Hollywood, Calif.

Farboil Epothanes—Farboil Co., Baltimore 30, Md.

Fel-Pro C5-A—Felt Products Mfg. Co., 7450 N. McCormick Blvd., Skokie, Ill.

Ferro-Tic S-45 and S-55—Sintercast Division, Chromalloy Corpn., 132 Woodworth Ave., Yonkers 2, N. Y.

Haynes 90, 94, and 4560; Nickel-Manganese, Hascrome, and Haystellite Tube Rods—Haynes Stellite Co., Division of Union Carbide Corpn., 420 Lexington Ave., New York 17, N. Y.

Hydra-Gard—Gard Products Co., Kansas City, Kan.

Jet-Dri Multi Surface Rust Inhibiting Primer—Consolidated Chemical & Paint Mfg. Co., Inc., 456 Driggs Ave., Brooklyn, N. Y.

Kawecki Tantalum Sheet—Kawecki Chemical Co., Boyertown, Pa.

Kelite Spray Cleaner No. 5-S—Kelite Corpn., 81 Industrial Road, Berkeley Heights, N. J.

Kennametal Grade K165—Kennametal Inc., Latrobe, Pa.

KPO No. 1—Keystone Lubricating Co., 3100 N. 21 St., Philadelphia 32, Pa.

Mallory 3000—Mallory Metallurgical Co., Division of P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind

Maraset Laminating Resin No. 607-AA and Maraset Brilliant White Gel Coat No. 606—Marblette Corpn. 37-21 30 St., Long Island City 1, N. Y.

Met-All—Anton Co., 55 Front St., New York 4, N. Y.

Metallite Type 101—Behr Manning Co., Division of Norton Co., Troy, N. Y.

Microthene Polyethylene—U. S. Industrial Chemicals Co., Division of National Distillers & Chemical Corpn., 99 Park Ave., New York 16, N. Y.

Miracoil—Enamelstrip Corpn., Subsidiary of National Steel Corpn., Grant Bldg., Pittsburgh 19, Pa.

Nicrobraz Standard-W, 30-W, 50-W, 60-W, 130-W, 150-W, and LM-W—Stainless Processing Division, Wall Colmonoy Corpn., 19345 John R St., Detroit 3, Mich.

Nironze 635—Bridgeport Brass Co., Bridgeport 2, Conn.

No-Gall Cutting Compound—Hal Industries, Box 224, Wyckoff, N. J.

Nylaflow Pressure Hose—Polymer Corpn., of Pennsylvania, 2140 Fairmont Ave., Reading, Pa.

PA-746—Plastic Associates, 185 Mountain Road, Laguna Beach, Calif.

Pennzoil Special Multi-Purpose Lubricant—Pennzoil, South Penn Oil Co., Oil City, Pa.

Pfaudler F-C Glasteel Pipe—Pfaudler Division of Pfaudler Permutit Inc., 1098 West Ave., Rochester 11, N. Y.

Plasmarc—Linde Company, Division of Union Carbide Corpn., 30 E. 42 St., New York 17, N. Y.

Plastic Lead Seal—Crane Packing Co., Dept. MY-3, 6400 Oakton St., Morton Grove, Ill.

Polypenco Nylon—Polymer Corpn., 2120 Fairmont Ave., Reading, Pa.

Potomac A—Allegheny Ludlum Steel Corpn., Oliver Bldg., Pittsburgh 22, Pa.

Poxylube—Poly Chem, 541 S. Webster, Indianapolis 19, Ind.

Quick Strip No. 5—Mitchell-Bradford Chemical Co., Wampus Lane, Milford, Conn.

Release-Cote—Potdevin Machine Co., 285 North St., Teterboro, N. J.

Resin-Bonded Quartz Sheet—Cordo Molding Products, Inc., 230 Park Ave., New York City

Roblinger P.M.C. Stainless-Steel Shim Stock—Roblinger Co., 40 Cross East, Boston, Mass.

Ryerson Hydraulic Tubing—Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80, Ill.

Scotch Brand Dusting Fabric No. 550—Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.

Scotch Brand Electrical Tape Nos. X-1111 and X-1112—Minnesota Mining & Mfg. Co., Dept., S9-483, 900 Bush Ave., St. Paul 6, Minn.

Seamless Tantalum Tubing—Wolverine Tube Division, Calumet & Hecla, Inc., 17200 Southfield Road, Allen Park, Mich.

17-7 PH Spring Wire—National-Standard Co., Niles, Mich.

Skalix—Navan Products, Inc., Los Angeles, Calif.

Sprayon No. 604 Antirust Spray and No. 603 Blue Layout Spray—Industrial Supply Division, Sprayon Products Inc., 2075 E. 65 St., Cleveland 3, Ohio

Review of Some Recently Developed Materials—Continued

Names and Addresses of Manufacturers of Products Listed

Staimet—Union Carbide Metals Co., Division of Union Carbide Corpn., 30 E. 42 St., New York 17, N. Y.

Standard Tubing—Standard Tube Co., 24400 Plymouth Road, Detroit 39, Mich.

Superlume—Hanson-Van Winkle-Munning Co., 100 Church St., Matawan, N. J.

Superweld Brazing Alloy—Superweld Corpn., North Hollywood, Calif.

Texas Instruments Preclad Alloy—Texas Instruments, Inc., Metals & Controls Division, 34 Forest St., Attleboro, Mass.

Thermomelt—Markal Co., 3052 W. Carroll Ave., Chicago 12, Ill.

Thred-Tape—Crane Packing Co., Dept. MY-3, 6400 Oakton St., Morton Grove, Ill.

Titanium-Carbide Tool Bits—Ford Motor Co., Dearborn, Mich.

Triangle R—Morganite Inc., Refractories Division, 3300 48 Ave., Long Island City 1, N. Y.

Turcoat Low Temp—Turco Products, Inc., 24600 S. Main St., Wilmington, Calif.

Type Q Medium—Techline Division, Wheelabrator Corpn., 1147 Avenue V, Vicksburg, Mich.

Type RS-140—Republic Steel Corpn., 1441 Republic Bldg., Cleveland 1, Ohio

Unarco U-200—Union Asbestos & Rubber Co., Fibrous Products Division, Bloomington, Ill.

Unimach UCX2—Universal-Cyclops Steel Corpn., Bridgeville, Pa.

USS STRUX—United States Steel Corpn., 525 William Penn Place, Pittsburgh 30, Pa.

Vac-Arc AGT (SAE 9310) Steel—Latrobe Steel Co., Latrobe, Pa.

Wide Gap Alloys, General Purpose Alloys, and Honeycomb Brazing Alloys—Metallurgical Products Dept., General Electric Co., Detroit 32, Mich.

XS-4006 and SS-4005—Silicone Products Dept., General Electric Co., Waterford, N. Y.

Depreciation Laws Impede Creation of Jobs

According to a survey made by the American Economic Foundation, America's job-creating economic growth is being stunted by outmoded tax depreciation laws that critically hamper United States industry in replacing one-third of its machines considered technologically obsolete. The survey covered the opinions of thirty-three leading business and industrial organizations and companies which presented testimony before the 1960 House Ways and Means Committee hearing on depreciation policies.

The principal conclusions of business and industrial leaders were:

(1) Unless the tax depreciation laws are liberalized to give incentive to industry for investment in new machines, the United States economy will fail to grow fast enough to insure our prosperity and to meet the challenge by the Soviet Union for world industrial leadership.

(2) Present tax allowances do not take into account the twin problems of obsolescence and inflation which make it increasingly difficult for industry to acquire capital for replacement.

(3) The United States – burdened by $90,000,000,000 worth of aging and inefficient industrial tools—will continue to lose markets abroad and at home to foreign competitors who enjoy the double advantage of low pay scales and greater tax write-offs.

The American Standards Association has announced a new edition of a standard credited with bringing American and British industry into closer harmony. The American Standard Unified Screw Threads, B1.1-1960, published by the American Society of Mechanical Engineers, permits interchangeability of screws and fasteners on mechanisms produced by Canada, Britain, and the United States, with resultant savings in time, labor, and costs. The Unified Screw Thread is a direct result of the work accomplished by the ABC (American, British, Canadian) Conference on Unification of Engineering Standards.

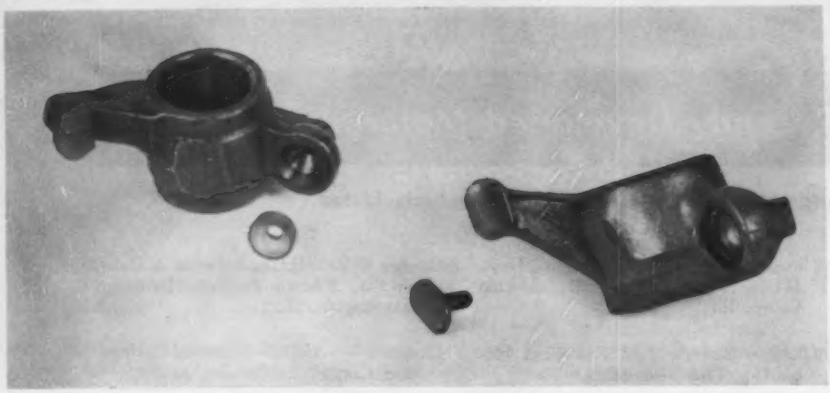


Fig. 1. Aluminum Buick rocker arm and two hardened steel components which are pressed into mating holes by an automatic machine of high-productive capacity.

HERBERT CHASE

MECHANIZED ASSEMBLY OF ROCKER ARMS

Not only are components assembled automatically by an eight-station machine but each unit is subjected to a bending test. Incomplete assemblies are rejected

ROCKER ARMS for 1960 Buick engines are die-cast from aluminum alloy. This practice constitutes a change from previous designs that was made primarily to considerably reduce the inertia forces. Economical assembly of the rocker-arm components necessitated the development of a unique automatic machine to be here described. The various components are fed to their assembly points from hoppers and by magazines.

The rocker arms are cast close to size and with a central hole cored so that it can be finished by a simple broaching operation. Two hardened steel inserts, shown in Fig. 1 with rocker arms, are the parts assembled by the equipment mentioned. One insert is a cold-headed pad having a stem that must be pressed into a drilled hole in the rocker arm. In service, this pad bears against the valve stem. The second insert is a small hardened steel cup having a spherical seat. This cup is pressed into a recess in the push-rod end of the rocker arm. The cup is then staked to insure permanent fastening. Finishing of the rocker arms themselves is done by eleven machines. Cuts are light, as little metal need be removed; hence the cuts can be taken at high speed.

Machined rocker-arm castings are hand-loaded into four Syntron hoppers of the Impco assembly machine, which is shown in Fig. 2. Operation of this eight-station indexing machine is completely automatic except for dumping the small parts into hoppers that load all magazines except the first set. Those are hand-loaded. At each station of the machine, four rocker arms undergo similar operations at the same time.

Each rocker arm is loaded over a pin that enters its large central hole. This is accomplished by advancing one rocker arm from each of the four hand-loaded magazines that are arranged side by side at the loading station. With the first indexing movement, all four rocker arms are moved to the second station, which is seen at the left in Fig. 2. Each of the two hoppers at this station feeds two track magazines. There is a magazine for each of the four fixtures. A magnet on each fixture picks up a spherical seat from the inner end of the corresponding magazine track, shifts the seat to a point above a rocker-arm recess, and then presses the seat into the recess. A single small hydraulic ram applies the necessary pressure on all four fixtures and then retracts the inserting punches.

After the four fixtures have advanced to the third station, seen at the center in Fig. 3, four punches stake the respective seats to the rocker arms at three points. Each punch is actuated by its own automatic riveting hammer. At the fourth station of the machine, the four rocker arms are repositioned to bring the valve pusher end of each arm above an anvil. These anvils bear against the underside of the boss on the rocker arms, as seen at the left in Fig. 3. Each boss has a central hole to receive the shank of the pad that is applied at Station 5. This station is at the right in Fig. 4.

At the fifth station there are also two Syntron hoppers for feeding pads into four track magazines, with the pad shanks pointing downward. At the inner end of each magazine, a magnet picks up one pad at a time, transfers it to the

Fig. 2. Four parallel magazines carry rocker arms to supporting pins at Station 1 (right) of the assembly machine. Push-rod seats fed from hoppers are pressed into the mating holes of the rocker arms at Station 2 (left).

proper position with respect to the rocker arm, lowers the pad shank, into the mating hole in the rocker arm, releases the pad, and then retracts, ready for the next cycle of the machine.

Thus, each rocker arm carries its own pad when the four rocker arms of one group are advanced simultaneously to Station 6 (seen at the left in Fig. 4). Here, four punches are lowered to press the pads firmly against the mating boss surfaces. Each of the punches is slotted on the end to position the pad so that its long axis will be parallel to the axis of the central rocker-arm hole before the pad is pressed home. The shanks are a press fit in their holes; therefore shifting of the pad does not occur in service.

At the seventh station of the machine, seen at the right in Fig. 5, each rocker arm is located below a punch. Cams bring jaws down on the rocker arms at points where they clear the lower side of the pad bosses. When the punches come down they apply a pressure of 1000 pounds on each pad. As the opposite end of each rocker arm rests on a fixed block and the rocker arm is free to turn on the supporting pin of the fixture, it is subjected to a bending stress much higher than will be applied in service. This bending test pro-

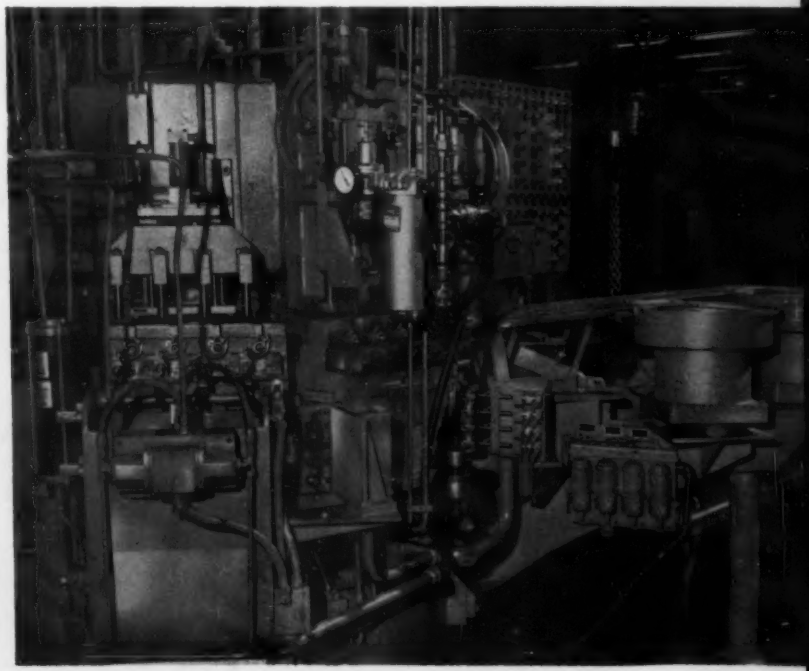


Fig. 3. At Station 3 (center) four staking tools, actuated by small hammers, fasten push-rod seats in place. At Station 4 (left) supports are raised under rocker-arm bosses for pad insertion.

Fig. 4. Each hopper at the right feeds pads into track magazines from which one pad is picked up by a magnet at each cycle and is placed with its shank in the mating hole of a rocker arm. At Station 6 (left) the pads are assembled.

vides a check against flaws in any casting that might be sufficient to cause breakage during use.

Limit switches at the eighth and final station of the machine are so arranged as to cause rejection of any rocker arm if, through faulty action at any prior station, either a spherical seat or a pad insert has not been assembled. If such a part is missing, these switches cause a gate to open in the corresponding discharge chute which appears at the left in Fig. 5. If the rocker arm assemblies are complete, however, the gates remain closed. Four assemblies slide down the chute at the same time when they are automatically pushed off their supporting pins. Properly completed assemblies slide down the chutes into tote boxes. Rejects, however, fall through any gate that has been opened and drop into a separate reject box.

Only one man is required to keep the magazines and hoppers loaded with work and to check the machine against any malfunction. As the machine is designed to make 1800 cycles an hour and completes the assembling and testing of four rocker arms with each cycle, output is exceptionally high and the labor charge, extremely low.

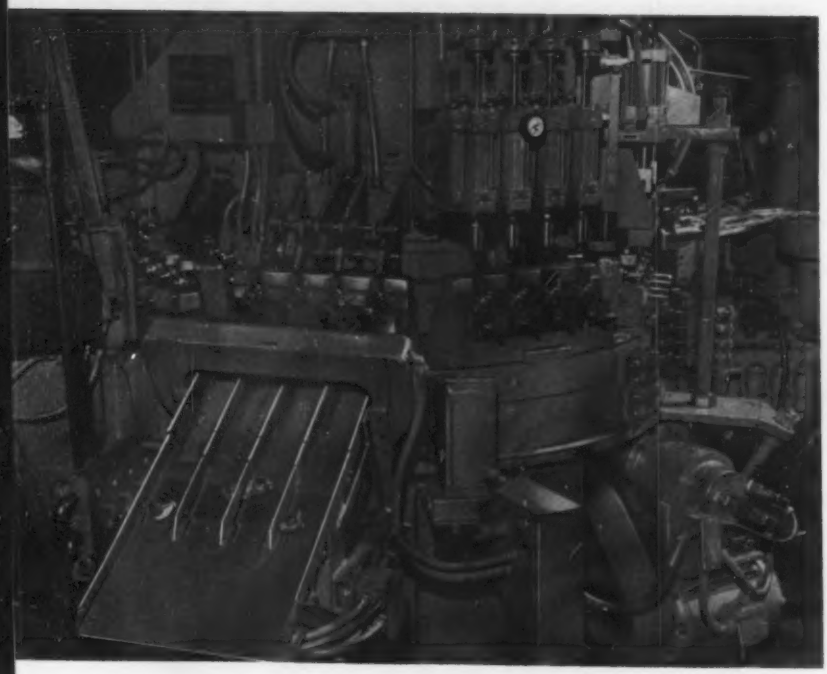


Fig. 5 At Station 7 (right) each rocker arm is given a bend test through the application of a 1000-pound load. Assembled rocker arms are ejected to the chutes at Station 8 (left). If any component of the assembly is missing, a chute receives the rejected rocker arm.

SHEARING DISCS SIMULTANEOUSLY TO OPPOSING ANGLES

Close limits are held and smooth surfaces obtained without grinding. Production rate is high and labor charges low

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AT FIRST GLANCE, the production of stamped butterfly throttle discs, such as seen at the bottom in Fig. 1, may seem to be a fairly simple procedure. However, when specifications call for a total tolerance of only 0.001 inch on disc edges that are not square with the top and bottom surfaces and which must make a close fit in circular throats that are machined to close limits, rapid production of the parts is far from being as simple as it may appear.

The Rochester Products Division of the General Motors Corporation produces many models of carburetors in large volume. Each carburetor requires one, two, or four throttle discs. In some models the discs must make a close fit with the throat when nearly, but not quite, at right angles to the throat axis. Other designs call for equally close fits when the discs are as much as 15 degrees from the axis. In each case, the edge of the disc makes positive contact around approximately half the circumference of the throat and negative contact around the opposite portion of the throat. For this reason, one half of the circumference must be tapered one way and the second half of the circumference, the opposite way.

Valve discs are first blanked (with square edges) from sheet metal, notched on opposite sides, as shown, for the transverse supporting stem. All discs are pierced to receive screws for fastening to the stem. In making the blank, all shearing cuts are taken at right angles to the blank faces. The circumferential portions of the discs between the notches must then be cut to the specified opposing angles and to the close diameter tolerance mentioned.

Formerly, the disc edges were finished by grinding on center, using arbors on which seven discs were clamped together at a time at the required angle. This method proved to be slow, partly because of the time required for loading and unloading the arbors. To obtain a higher production rate, it was decided to develop shearing

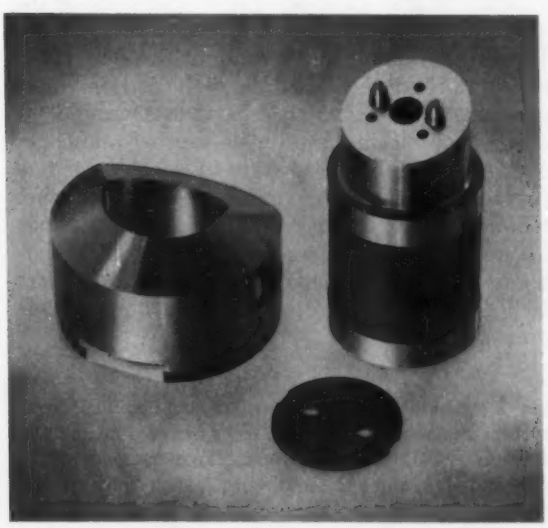

Fig. 1. Ingenious press tools which shear a smooth contour around the edge of throttle discs to opposite angles on the opposing sides. One of the throttle discs is seen at the bottom of this illustration.

tools for performing this operation on a hydraulic press. Different fixtures had to be made for holding the individual discs at the specified angles.

So that the operation could be performed rapidly, six fixtures are set up on the indexing table of an 8-ton Denison hydraulic press as shown in Fig. 2. This press is automatic except for loading the discs, this being done by hand at the front station.

Shearing is accomplished by employing an upper die member having two tapered faces as seen at the left in Fig. 1. Faces are ground so that the shearing cuts start and end at the disc notches. In other words, the edges of the shearing tool make circular cuts progressively around the respective arcs. This method results in relatively smooth, sheared surfaces that provide the desired close fits with the mating bores in the carburetors. Little or no burring occurs during shearing. There is some tendency for the blank to shift along the incline of the die member on which the workpiece is seated, but this is counteracted, as described later.

Disc blanks are sized in the earlier press operation so that the shearing tool need remove only from 0.005 to 0.007 inch of metal on a side. Only two chips apiece result. They are blown away by air jets at the shearing station and the following station, where there is a cam that activates ejector pins and a blow-off jet. All tools are made of hardened steel, and their shearing edges are kept sharp to insure clean cuts.

As the cuts are not taken square with the disc face, it is, of course, necessary to mount each disc at the angle required on the edges. Therefore, the flat face of the lower tool or die is ground to that angle. Initial positioning of the work-piece is accomplished by means of two pointed pins in the die which enter mating holes previously pierced in the disc. Although these pins make a fairly close fit in the holes, the angle of the supporting die face tends to produce a slight shift of the disc down the incline when the first cut on the disc is at its high point.

This shifting of the work originally prevented holding to the close diameter limits specified. For this reason, it was found necessary to dimple the discs before shearing. Protrusions formed on the underside make close fits in mating holes provided on the face of the die as shown. These dimples, in combination with a spring plunger inside of the upper shearing tool, press the disc tightly against the sloping face of the die and prevent any shifting of the disc. The dimples also serve as an aid in subsequent assembly of the disc to its stem because the projections help the operator to determine which disc flat should bear against the pivoting shaft.

To produce the dimples, a small hydraulic press is provided at a station ahead of the one where the shearing is accomplished. Punches produce the dimples by forcing metal into the mating holes on the inclined face of the bottom die.

The advantage of using a hydraulic press for shearing butterfly throttle discs is that the cut can be made at a uniform preset speed and at the proper pressure to yield smooth and precise cuts. It was considered best to mount the upper tool on a ram that is centered above the station where the shearing cuts are made, and to assemble the upper tool within a sturdy sleeve that telescopes over the close-fitting portion of each lower tool fixture. Use of the telescoping sleeve on the upper tool corrects any variation in the indexing of the fixture, thus insuring true alignment of the shearing tool and the bottom die. With this setup, from 1000 to 1100 discs are handled per hour by one press operator.

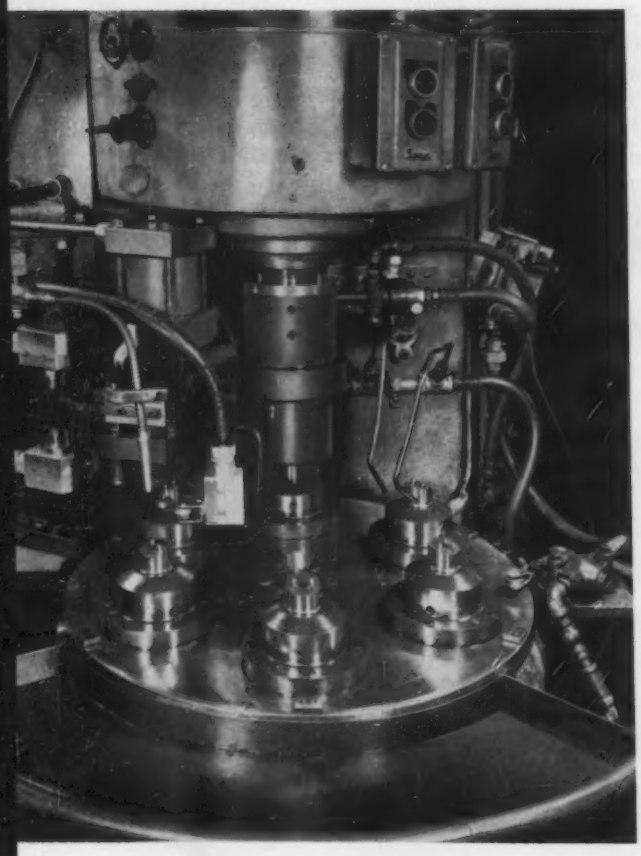

Fig. 2. An automatic indexing table on a hydraulic press enables the shearing of valve discs at rates up to 1100 per hour. Work-holding fixtures, such as seen at the right in Fig. 1, and one shearing tool, such as illustrated at the left, are provided.

MACHINERY'S Reference Section

PROFILE DEVIATIONS OF INVOLUTE GEARS

LOUIS D. MARTIN, Gear Consultant, Pasadena, Calif.

OCTOBER 1960

Profile Deviations of Involute Gears

With gears for consumer goods being made more and more by injection molding, sintering, and rolling, a simple and direct means of evaluating the tooth-profile deviation required on the tools used in these processes can be a great help to the designer. A chart and tables for determining the necessary departure from the nominal involute tooth profile due to expansion and contraction of the work-pieces are here presented

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Pasadena, Calif.

When gears are made of powdered metals, of plastics by injection molding, or by rolling processes, the tooth profile of the work-piece is different from that of the tools or molds. In some cases the part shrinks, and in other cases it expands. The tooth profile of the tooling employed in these processes must, therefore, be modified to compensate for such size variations.

When used as a design aid, the chart shown in Fig. 1 can simplify the predetermining of the tooth-profile modification required on the tooling. This graph gives the necessary deviation from the nominal tooth profile in terms of the per cent shrinkage or expansion known to occur in work-pieces made by a particular process.

In the case of rolling, the plastic flow of the material usually tends to produce teeth having higher profile angles. These changes, however, can also be evaluated in terms of the percentage deviation, either plus or minus, from the nominal tooth profile. In involute helicoids produced by rolling, the profile change on one side is usually different from that on the other. The profile of the thrust side of the tooth invariably has a higher pressure angle than the lag-side profile. Other uses suggested for this chart include evaluating profile ease-off commonly employed on highly stressed gears.

How the Chart Was Developed

Involute curves, generated from base circles of different diameters, have a similarity and proportionality based on the relative size of the base circles. Tangents drawn from base circles of different size (Fig. 2) to points (P_1 and P_2) on their respective involute curves at the same roll angle (ε) vary in length an amount which is proportional to the difference in their base diameters. Thus, if the length of one tangent, C_1 (radius of curvature at P_1), is 10 per cent smaller than that of the other tangent, C_2 (radius of curvature at P_2), the base circles from which they were drawn will also exhibit a 10 per cent difference in size. This property of involutes has been called photographic similarity.

In Fig. 3, the right triangle formed by lines R_o, R_b, and C is similar to other right triangles having sides of the same relative proportions. If the length of leg R_b, of the right triangle is increased a given percentage, leg C is increased a like percentage. Since the length of leg C is the distance from the point of tangency on the base circle to a point P on the involute intersected by a radial line, the lengthening or shortening of leg C can be plotted as a deviation from the nominal involute profile of a gear at point P when the base radius R_b, is reduced or enlarged from a nominal value.

To find the deviation in involute profile due to an increase or decrease of the base radius R_b, it is necessary to know: (1) the base radius R_b, (2) the radius R_o to the point P where profile deviation is to be determined, and (3) the roll angle ε.

The mathematical derivations of the equations used to compile the data for the chart shown in Fig. 1 are based on the diagrams in Figs. 2 and 3 as follows:

In Fig. 3,

$$C = \sqrt{R_o^2 - R_b^2}$$

$$\epsilon \text{ in radians} = \frac{\sqrt{R_o^2 - R_b^2}}{R_b}$$

$$\epsilon \text{ in degrees} = \epsilon \text{ in radians} \times 57.29578$$

$$\cos\phi = \frac{R_b}{R_o}$$

$$\theta = \epsilon \text{ in degrees} - \phi$$

where

R_o is a radius drawn to any point P on an involute curve

R_b is the radius of the base circle of the involute curve

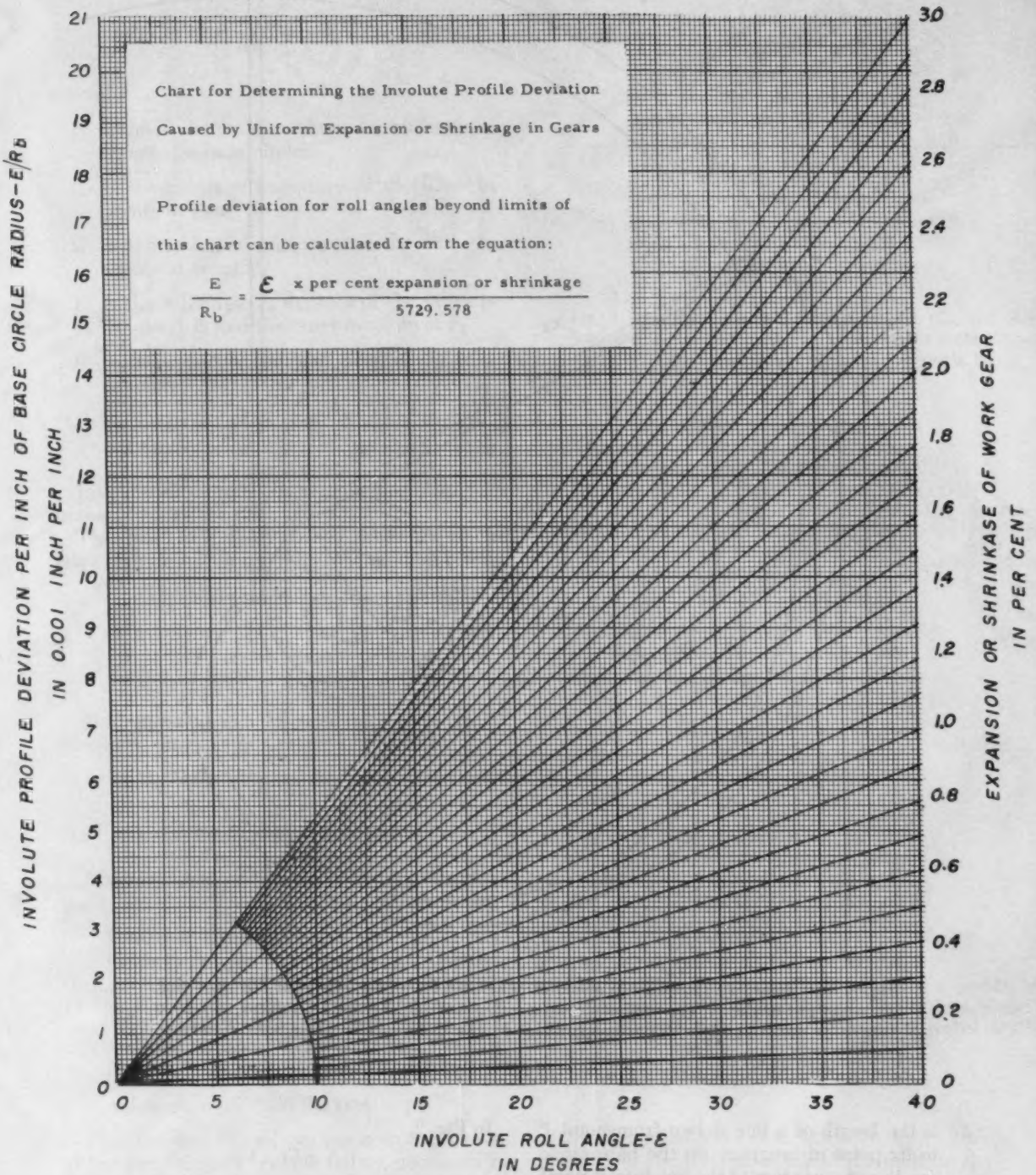


Chart for Determining the Involute Profile Deviation
Caused by Uniform Expansion or Shrinkage in Gears
Profile deviation for roll angles beyond limits of this chart can be calculated from the equation:
E/Rb = ε x per cent expansion or shrinkage / 5729.578
INVOLUTE PROFILE DEVIATION PER INCH OF BASE CIRCLE RADIUS-E/Rb
IN 0.001 INCH PER INCH
EXPANSION OR SHRINKAGE OF WORK GEAR
IN PER CENT
INVOLUTE ROLL ANGLE-ε
IN DEGREES
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0
0 5 10 15 20 25 30 35 40

Fig. 1. Profile deviation values are charted here on a per inch of base-circle radius basis. Expansion results in a positive profile deviation (smaller pressure angle), while shrinkage results in a negative profile deviation (greater pressure angle).

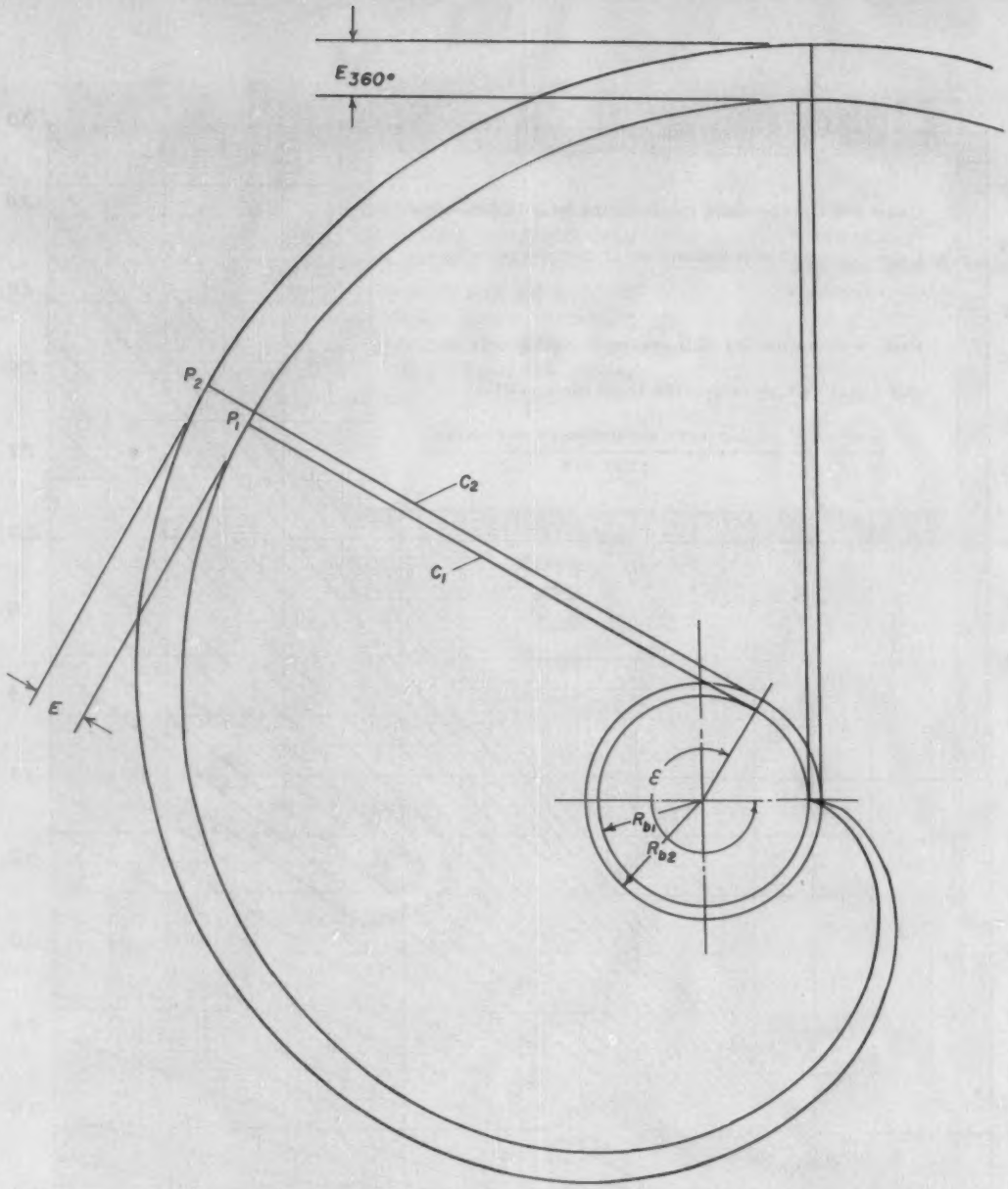


Fig. 2. This diagram compares two involutes generated from base circles of different size. At equal roll angles (ε) the radii of curvature (C_1) and (C_2) of these involutes vary by a length or deviation (E) which is proportional to the difference in their base diameters.

C is the length of a line drawn from point P to its point of tangency on the base circle (radius of curvature of the involute at point P)

ε is the angle subtending an arc of length C at radius R_b (roll angle of the involute curve at point P)

ϕ is the pressure angle at point P

θ is the polar angle to point P

In Fig. 2,

$$E = C_2 - C_1$$

but since

$$C_1 = \frac{\pi \epsilon R_{b1}}{180}$$

and

$$C_2 = \frac{\pi \epsilon R_{b2}}{180}$$

Substitution of these values for C_1 and C_2 gives the relation

$$E = \frac{\pi \epsilon}{180} (R_{b2} - R_{b1})$$

where

E is the deviation in involutes drawn from different-size base circles

C_1 is the radius of curvature of the inner involute at point P_1

C_2 is the radius of curvature of the outer involute at point P_2

E is the roll angle in degrees of the inner involute at P_1 and the outer involute at P_2

R_{b1} is the radius of the base circle of the inner involute

R_{b2} is the radius of the base circle of the outer involute

Involute deviation E is seen in Fig. 2 to vary uniformly with the roll angle ε.

The chart in Fig. 1 is based primarily on the last equation but in the following modified form:

$$E = \frac{\epsilon\ (R_b \times \text{per cent expansion or shrinkage})}{57.29578 \times 100}$$

$$E/R_b = \frac{\epsilon \times \text{per cent expansion or shrinkage}}{5729.578}$$

This equation can be used to obtain profile deviations in cases not covered by the chart.

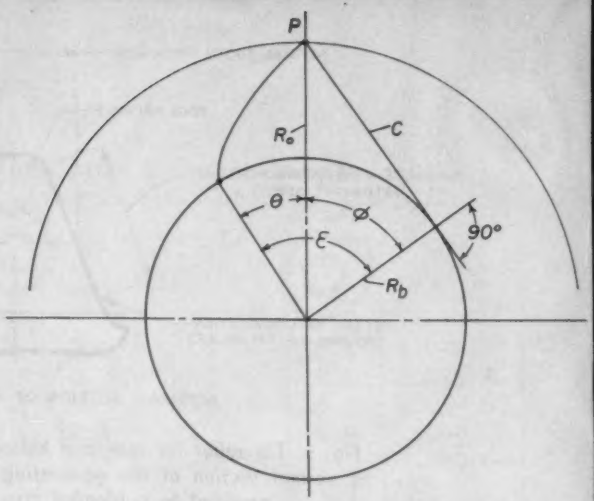


Fig. 3. The right triangle formed by (R_o), (C), and (R_b) is proportional to right triangles formed by the same elements of other involutes at the same roll angle (ε).

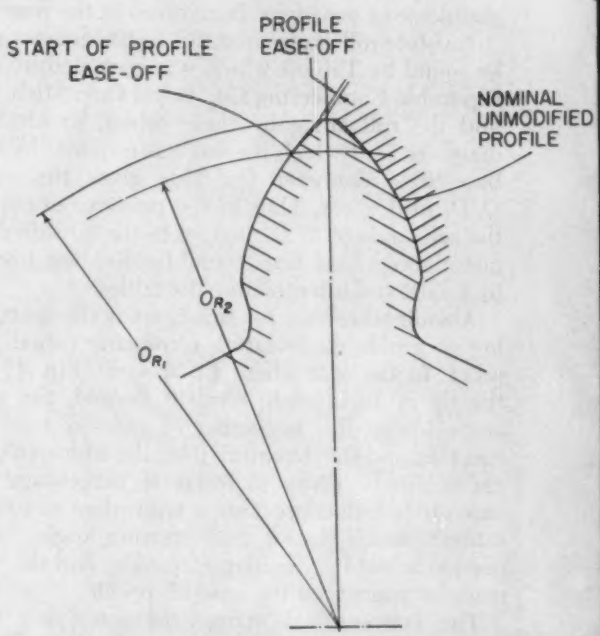


Fig. 4. The profile ease-off shown here is a portion of an involute curve generated from a smaller base circle and displaced until it touches the nominal profile at (O_{R2}).

How to Use the Chart

Example: A gear has the following specifications:

Twenty-five teeth
16 pitch
pitch diameter—1.5625 inches
outside diameter—1.6875 inches
pressure angle—25 degrees
base diameter—1.4161 inches
roll angle ε—37.1336 degrees

Find the departure from the nominal involute at the periphery, or outside radius, necessary for tooling or for molds used to make gears having a base diameter shrinkage of 1.0 per cent.

In solving this problem, enter the bottom of the chart at an involute roll angle value of 37.13 degrees and rise to intersect the radial line representing a 1.0 per cent shrinkage (or expansion). The scale for these values is at the *right* side of chart. From this point of intersection, move horizontally to the *left* and read 0.0065 inch on the scale for involute profile deviation per inch of base-circle radius E/R_b. Next multiply 0.0065 inch by the base-circle radius ($\frac{1.14161}{2} = 0.70805$ inch). This product, 0.0046 inch, is the deviation E from the nominal involute required for the

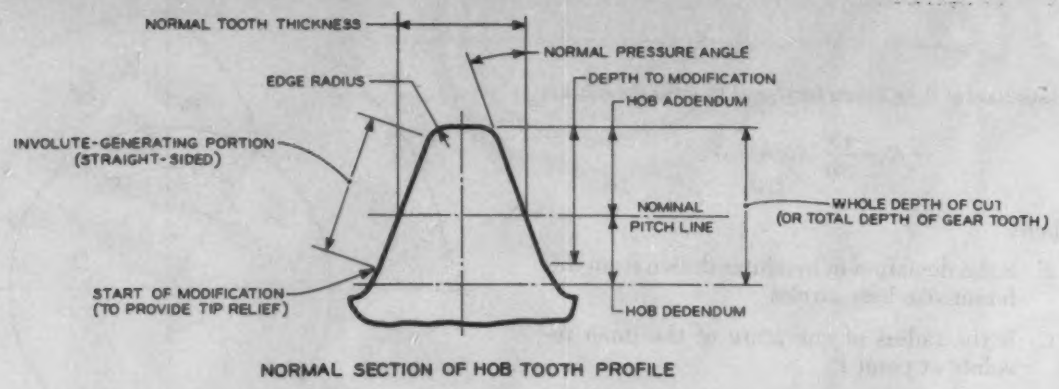

NORMAL TOOTH THICKNESS
NORMAL PRESSURE ANGLE
EDGE RADIUS
DEPTH TO MODIFICATION
HOB ADDENDUM
INVOLUTE-GENERATING PORTION (STRAIGHT-SIDED)
NOMINAL PITCH LINE
WHOLE DEPTH OF CUT (OR TOTAL DEPTH OF GEAR TOOTH)
START OF MODIFICATION (TO PROVIDE TIP RELIEF)
HOB DEDENDUM
NORMAL SECTION OF HOB TOOTH PROFILE

Fig. 5. Tip relief for spur and helical gears is conventionally specified by showing a normal section of the generating hob. In the hob here illustrated, tip relief is provided by a blended straight portion of higher pressure angle.

tooling. The "sense" of this deviation can be either plus or minus, depending on whether shrinkage or expansion is involved in the process.

Involute roll angles from 0.1 to 100 degrees can be found by Table 1 which was compiled by the Equitable Engineering Co., Royal Oak, Mich. To find the roll angle by these tables, divide the diameter D at which the angle is required by the base-circle diameter D_b. This gives the ratio D/D_b in degrees. Thus in the previous example, the roll angle of 37.13 degrees to the outside diameter could have been found by dividing 1.6875 by 1.4161 and interpolating the tables.

Among other uses for this chart is the specifying of profile modification commonly called tip relief. In the case where an ease-off (Fig. 4) at the tip of an involute tooth is desired, the roll angle up to the beginning of ease-off can be specified and the departure from the true involute curve can be given in terms of percentage of base-circle reduction. This is equivalent to using a tooth profile with a dual pressure angle. One portion is the fully conjugate profile, and the remainder consists of the ease-off profile.

The conventional manner of specifying tip relief in spur and helical gears is to show a normal section of the generating hob as illustrated in Fig. 5, which is taken from the American Gear Manufacturers Association (AGMA) Standard 121.02. The involute-generating portion is given as a straight line of arbitrary length, and the modification, to provide tip relief, is at the end of the straight line. The approach portion may be an arbitrary curve, as shown on page 455 of *The Metal Cutting Tool Handbook*, or a "blended" straight portion of higher pressure angle as given in AGMA Standard 121.02.

There is no well-defined way of specifying profile ease-off other than to refer back to the tooling. Futhermore, the tool that produces the desired amount of ease-off for the driving member may not be suitable for the mating member. A much more practical manner of specifying profile ease-off is illustrated in Fig. 4. This will result in a dual pressure-angle hob, similar to that shown in Fig. 5.

To find the desired amount of ease-off, proceed as follows:

1. Select the point where ease-off is to begin and determine the roll angle ε at this point from roll-angle tables.

2. Select the amount of ease-off to the tip of the tooth. Then, on the profile deviation scale shown on the left of the chart, follow the line for the selected ease-off value until it coincides with the desired roll-angle ε at the start of ease-off.

3. Next, follow the diagonal line intersected at this point to the scale at the right of the chart. This will give the percentage difference of the base-circle diameter D from the base diameter D_{b1}, from which the ease-off curve is to be generated. In the case of ease-off, the base diameter of the relieved portion is always smaller than the pitch diameter D of the standard unmodified portion of the involute tooth. If the difference in profile angle is desired, it can be found by dividing the base diameter of the modified portion of the tooth by the standard pitch diameter. This will give the cosine of the profile angle. Thus:

$$\text{Cos } \phi_1 = \frac{D}{D_{b1}}$$

in which

$\text{Cos } \varphi_1$ = Profile angle of modified portion
D = Standard pitch diameter
D_{b1} = Base diameter of tip-relief curve

The profile angle is useful in specifying the generating tool or hob.

Table for obtaining roll angle ε of involute generated from a base circle of diameter D_b at diameter D_x . Roll angle ε is given in terms of the ratio D_x/D_b

ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b
0.1	1.000 00	4.1	1.002 56	8.1	1.009 94	12.1	1.022 06	16.1	1.038 73
0.2	1.000 01	4.2	1.002 68	8.2	1.010 19	12.2	1.022 42	16.2	1.039 20
0.3	1.000 01	4.3	1.002 81	8.3	1.010 44	12.3	1.022 78	16.3	1.039 68
0.4	1.000 02	4.4	1.002 94	8.4	1.010 69	12.4	1.023 15	16.4	1.040 16
0.5	1.000 04	4.5	1.003 08	8.5	1.010 94	12.5	1.023 52	16.5	1.040 64
0.6	1.000 05	4.6	1.003 22	8.6	1.011 20	12.6	1.023 90	16.6	1.041 12
0.7	1.000 07	4.7	1.003 36	8.7	1.011 46	12.7	1.024 27	16.7	1.041 61
0.8	1.000 10	4.8	1.003 50	8.8	1.011 73	12.8	1.024 65	16.8	1.042 10
0.9	1.000 12	4.9	1.003 65	8.9	1.011 99	12.9	1.025 03	16.9	1.042 59
1.0	1.000 15	5.0	1.003 80	9.0	1.012 26	13.0	1.025 42	17.0	1.043 09
1.1	1.000 18	5.1	1.003 95	9.1	1.012 53	13.1	1.025 80	17.1	1.043 59
1.2	1.000 22	5.2	1.004 11	9.2	1.012 81	13.2	1.026 20	17.2	1.044 09
1.3	1.000 26	5.3	1.004 27	9.3	1.013 09	13.3	1.026 59	17.3	1.044 59
1.4	1.000 30	5.4	1.004 43	9.4	1.013 37	13.4	1.026 98	17.4	1.045 10
1.5	1.000 34	5.5	1.004 60	9.5	1.013 65	13.5	1.027 38	17.5	1.045 60
1.6	1.000 39	5.6	1.004 77	9.6	1.013 94	13.6	1.027 79	17.6	1.046 12
1.7	1.000 44	5.7	1.004 94	9.7	1.014 23	13.7	1.028 19	17.7	1.046 63
1.8	1.000 49	5.8	1.005 11	9.8	1.014 52	13.8	1.028 60	17.8	1.047 15
1.9	1.000 55	5.9	1.005 29	9.9	1.014 82	13.9	1.029 01	17.9	1.047 67
2.0	1.000 61	6.0	1.005 47	10.0	1.015 12	14.0	1.029 42	18.0	1.048 19
2.1	1.000 67	6.1	1.005 55	10.1	1.015 42	14.1	1.029 84	18.1	1.048 71
2.2	1.000 74	6.2	1.005 84	10.2	1.015 72	14.2	1.030 25	18.2	1.049 24
2.3	1.000 81	6.3	1.006 03	10.3	1.016 03	14.3	1.030 68	18.3	1.049 77
2.4	1.000 88	6.4	1.006 22	10.4	1.016 34	14.4	1.031 10	18.4	1.050 30
2.5	1.000 95	6.5	1.006 41	10.5	1.016 65	14.5	1.031 53	18.5	1.050 84
2.6	1.001 03	6.6	1.006 61	10.6	1.016 97	14.6	1.031 96	18.6	1.051 37
2.7	1.001 11	6.7	1.006 81	10.7	1.017 29	14.7	1.032 39	18.7	1.051 91
2.8	1.001 19	6.8	1.007 02	10.8	1.017 61	14.8	1.032 82	18.8	1.052 46
2.9	1.001 28	6.9	1.007 23	10.9	1.017 93	14.9	1.033 26	18.9	1.053 00
3.0	1.001 37	7.0	1.007 44	11.0	1.018 26	15.0	1.033 70	19.0	1.053 55
3.1	1.001 46	7.1	1.007 65	11.1	1.018 59	15.1	1.034 14	19.1	1.054 10
3.2	1.001 56	7.2	1.007 86	11.2	1.018 93	15.2	1.034 59	19.2	1.054 65
3.3	1.001 66	7.3	1.008 08	11.3	1.019 26	15.3	1.035 04	19.3	1.055 21
3.4	1.001 76	7.4	1.008 31	11.4	1.019 60	15.4	1.035 49	19.4	1.055 77
3.5	1.001 86	7.5	1.008 53	11.5	1.019 94	15.5	1.035 95	19.5	1.056 33
3.6	1.001 97	7.6	1.008 76	11.6	1.020 29	15.6	1.036 40	19.6	1.056 89
3.7	1.002 08	7.7	1.008 99	11.7	1.020 64	15.7	1.036 86	19.7	1.057 46
3.8	1.002 20	7.8	1.009 22	11.8	1.020 99	15.8	1.037 33	19.8	1.058 03
3.9	1.002 31	7.9	1.009 46	11.9	1.021 34	15.9	1.037 79	19.9	1.058 60
4.0	1.002 43	8.0	1.009 70	12.0	1.021 70	16.0	1.038 26	20.0	1.059 17

Table for obtaining roll angle ε of involute generated from a base circle of diameter D_b at diameter D_x. Roll angle ε is given in terms of the ratio D_x/D_b

(Continued)

ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b
20.1	1.059 75	24.1	1.084 86	28.1	1.113 79	32.1	1.146 25	36.1	1.181 94
20.2	1.060 33	24.2	1.085 54	28.2	1.114 56	32.2	1.147 10	36.2	1.182 87
20.3	1.060 91	24.3	1.086 22	28.3	1.115 33	32.3	1.147 96	36.3	1.183 80
20.4	1.061 49	24.4	1.086 90	28.4	1.116 11	32.4	1.148 81	36.4	1.184 74
20.5	1.062 08	24.5	1.087 59	28.5	1.116 88	32.5	1.149 67	36.5	1.185 68
20.6	1.062 67	24.6	1.088 27	28.6	1.117 66	32.6	1.150 54	36.6	1.186 61
20.7	1.063 26	24.7	1.088 96	28.7	1.118 44	32.7	1.151 40	36.7	1.187 55
20.8	1.063 86	24.8	1.089 66	28.8	1.119 22	32.8	1.152 27	36.8	1.188 50
20.9	1.064 45	24.9	1.090 35	28.9	1.120 01	32.9	1.153 14	36.9	1.189 44
21.0	1.065 05	25.0	1.091 05	29.0	1.120 80	33.0	1.154 01	37.0	1.190 39
21.1	1.065 65	25.1	1.091 75	29.1	1.121 59	33.1	1.154 88	37.1	1.191 33
21.2	1.066 26	25.2	1.092 45	29.2	1.122 38	33.2	1.155 75	37.2	1.192 28
21.3	1.066 87	25.3	1.093 15	29.3	1.123 17	33.3	1.156 63	37.3	1.193 24
21.4	1.067 47	25.4	1.093 86	29.4	1.123 97	33.4	1.157 51	37.4	1.194 19
21.5	1.068 09	25.5	1.094 57	29.5	1.124 76	33.5	1.158 39	37.5	1.195 14
21.6	1.068 70	25.6	1.095 28	29.6	1.125 56	33.6	1.159 27	37.6	1.196 10
21.7	1.069 32	25.7	1.095 99	29.7	1.126 37	33.7	1.160 15	37.7	1.197 06
21.8	1.069 94	25.8	1.096 71	29.8	1.127 17	33.8	1.161 04	37.8	1.198 02
21.9	1.070 56	25.9	1.097 42	29.9	1.127 98	33.9	1.161 92	37.9	1.198 98
22.0	1.071 18	26.0	1.098 14	30.0	1.128 79	34.0	1.162 81	38.0	1.199 94
22.1	1.071 81	26.1	1.098 87	30.1	1.129 60	34.1	1.163 71	38.1	1.200 91
22.2	1.072 44	26.2	1.099 55	30.2	1.130 41	34.2	1.164 60	38.2	1.201 88
22.3	1.073 07	26.3	1.100 32	30.3	1.131 22	34.3	1.165 50	38.3	1.202 85
22.4	1.073 71	26.4	1.101 05	30.4	1.132 04	34.4	1.166 39	38.4	1.203 82
22.5	1.074 34	26.5	1.101 78	30.5	1.132 86	34.5	1.167 29	38.5	1.204 79
22.6	1.074 98	26.6	1.102 51	30.6	1.133 68	34.6	1.168 19	38.6	1.205 76
22.7	1.075 62	26.7	1.103 25	30.7	1.134 50	34.7	1.169 10	38.7	1.206 74
22.8	1.076 27	26.8	1.103 99	30.8	1.135 33	34.8	1.170 00	38.8	1.207 72
22.9	1.076 91	26.9	1.104 73	30.9	1.136 16	34.9	1.170 91	38.9	1.208 70
23.0	1.077 56	27.0	1.105 47	31.0	1.136 99	35.0	1.171 82	39.0	1.209 68
23.1	1.078 21	27.1	1.106 22	31.1	1.137 82	35.1	1.172 73	39.1	1.210 66
23.2	1.078 87	27.2	1.106 96	31.2	1.138 65	35.2	1.173 64	39.2	1.211 65
23.3	1.079 52	27.3	1.107 71	31.3	1.139 49	35.3	1.174 56	39.3	1.212 63
23.4	1.080 18	27.4	1.108 46	31.4	1.140 32	35.4	1.175 47	39.4	1.213 62
23.5	1.080 84	27.5	1.109 22	31.5	1.141 16	35.5	1.176 39	39.5	1.214 61
23.6	1.081 51	27.6	1.109 98	31.6	1.142 01	35.6	1.177 31	39.6	1.215 60
23.7	1.082 17	27.7	1.110 73	31.7	1.142 85	35.7	1.178 23	39.7	1.216 60
23.8	1.082 84	27.8	1.111 49	31.8	1.143 70	35.8	1.179 16	39.8	1.217 59
23.9	1.083 51	27.9	1.112 26	31.9	1.144 54	35.9	1.180 08	39.9	1.218 59
24.0	1.084 19	28.0	1.113 02	32.0	1.145 39	36.0	1.181 01	40.0	1.219 59

Table for obtaining roll angle ε of involute generated from a base circle of diameter D_b at diameter D_x. Roll angle ε is given in terms of the ratio D_x/D_b
(Continued)

ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b
40.1	1.220 58	44.1	1.261 91	48.1	1.305 67	52.1	1.351 61	56.1	1.399 53
40.2	1.221 59	44.2	1.262 98	48.2	1.306 79	52.2	1.352 79	56.2	1.400 76
40.3	1.222 59	44.3	1.264 04	48.3	1.307 91	52.3	1.353 96	56.3	1.401 98
40.4	1.223 59	44.4	1.265 11	48.4	1.309 04	52.4	1.355 14	56.4	1.403 20
40.5	1.224 60	44.5	1.266 18	48.5	1.310 17	52.5	1.356 32	56.5	1.404 43
40.6	1.225 61	44.6	1.267 25	48.6	1.311 29	52.6	1.357 50	56.6	1.405 65
40.7	1.226 62	44.7	1.268 33	48.7	1.312 42	52.7	1.358 68	56.7	1.406 88
40.8	1.227 63	44.8	1.269 40	48.8	1.313 56	52.8	1.359 86	56.8	1.408 11
40.9	1.228 64	44.9	1.270 48	48.9	1.314 69	52.9	1.361 05	56.9	1.409 34
41.0	1.229 66	45.0	1.271 55	49.0	1.315 82	53.0	1.362 23	57.0	1.410 57
41.1	1.230 68	45.1	1.272 63	49.1	1.316 96	53.1	1.363 42	57.1	1.411 80
41.2	1.231 69	45.2	1.273 71	49.2	1.318 09	53.2	1.364 60	57.2	1.413 03
41.3	1.232 71	45.3	1.274 80	49.3	1.319 23	53.3	1.365 79	57.3	1.414 27
41.4	1.233 74	45.4	1.275 88	49.4	1.320 37	53.4	1.366 98	57.4	1.415 50
41.5	1.234 76	45.5	1.276 96	49.5	1,321 51	53.5	1.368 17	57.5	1.416 74
41.6	1.235 78	45.6	1.278 05	49.6	1.322 65	53.6	1.369 36	57.6	1.417 97
41.7	1.236 81	45.7	1.279 14	49.7	1.323 79	53.7	1.370 56	57.7	1.419 21
41.8	1.237 84	45.8	1.280 23	49.8	1.324 94	53.8	1.371 75	57.8	1.420 45
41.9	1.238 87	45.9	1.281 32	49.9	1.326 08	53.9	1.372 94	57.9	1.421 69
42.0	1.239 90	46.0	1.282 41	50.0	1.327 23	54.0	1.374 14	58.0	1.422 93
42.1	1.240 93	46.1	1.283 50	50.1	1.328 38	54.1	1.375 34	58.1	1.424 17
42.2	1.241 96	46.2	1.284 60	50.2	1.329 53	54.2	1.376 54	58.2	1.425 42
42.3	1.243 00	46.3	1.285 69	50.3	1.330 68	54.3	1.377 74	58.3	1.426 66
42.4	1.244 04	46.4	1.286 79	50.4	1.331 83	54.4	1.378 94	58.4	1.427 91
42.5	1.245 08	46.5	1.287 89	50.5	1.332 99	54.5	1.380 14	58.5	1.429 15
42.6	1.246 12	46.6	1.288 99	50.6	1.334 14	54.6	1.381 34	58.6	1.430 40
42.7	1.247 16	46.7	1.290 09	50.7	1.335 30	54.7	1.382 55	58.7	1.431 65
42.8	1.248 20	46.8	1.291 20	50.8	1.336 45	54.8	1.383 76	58.8	1.432 90
42.9	1.249 25	46.9	1.292 30	50.9	1.337 61	54.9	1.384 96	58.9	1.434 15
43.0	1.250 29	47.0	1.293 41	51.0	1.338 77	55.0	1.386 17	59.0	1.435 40
43.1	1.251 34	47.1	1.294 51	51.1	1.339 93	55.1	1.387 38	59.1	1.436 65
43.2	1.252 39	47.2	1.295 62	51.2	1.341 10	55.2	1.388 59	59.2	1.437 91
43.3	1.253 44	47.3	1.296 73	51.3	1.342 26	55.3	1.389 80	59.3	1.439 16
43.4	1.254 50	47.4	1.297 85	51.4	1.343 42	55.4	1.391 01	59.4	1.440 42
43.5	1.255 55	47.5	1.298 96	51.5	1.344 59	55.5	1.392 23	59.5	1.441 67
43.6	1.256 61	47.6	1.300 07	51.6	1.345 76	55.6	1.393 44	59.6	1.442 93
43.7	1.257 67	47.7	1.301 19	51.7	1.346 93	55.7	1.394 66	59.7	1.444 19
43.8	1.258 73	47.8	1.302 31	51.8	1.348 10	55.8	1.395 88	59.8	1.445 45
43.9	1.259 79	47.9	1.303 43	51.9	1.349 27	55.9	1.397 09	59.9	1.446 71
44.0	1.260 85	48.0	1.304 55	52.0	1.350 44	56.0	1.398 31	60.0	1.447 97

Table for obtaining roll angle ε of involute generated from a base circle of diameter D_b at diameter D_x. Roll angle ε is given in terms of the ratio D_x/D_b
(Continued)

ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b
60.1	1.449 23	64.1	1.500 54	68.1	1.553 29	72.1	1.607 34	76.1	1.662 56
60.2	1.450 50	64.2	1.501 84	68.2	1.554 62	72.2	1.608 70	76.2	1.663 95
60.3	1.451 76	64.3	1.503 14	68.3	1.555 96	72.3	1.610 07	76.3	1.665 35
60.4	1.453 03	64.4	1.504 45	68.4	1.557 30	72.4	1.611 44	76.4	1.666 75
60.5	1.454 30	64.5	1.505 75	68.5	1.558 63	72.5	1.612 81	76.5	1.668 14
60.6	1.455 56	64.6	1.507 06	68.6	1.559 97	72.6	1.614 18	76.6	1.669 54
60.7	1.456 83	64.7	1.508 36	68.7	1.561 31	72.7	1.615 55	76.7	1.670 94
60.8	1.458 10	64.8	1.509 67	68.8	1.562 65	72.8	1.616 92	76.8	1.672 34
60.9	1.459 37	64.9	1.510 98	68.9	1.564 00	72.9	1.618 29	76.9	1.673 73
61.0	1.460 64	65.0	1.512 29	69.0	1.565 34	73.0	1.619 66	77.0	1.675 13
61.1	1.461 92	65.1	1.513 60	69.1	1.566 68	73.1	1.621 04	77.1	1.676 54
61.2	1.463 19	65.2	1.514 91	69.2	1.568 03	73.2	1.622 41	77.2	1.677 94
61.3	1.464 47	65.3	1.516 22	69.3	1.569 37	73.3	1.623 78	77.3	1.679 34
61.4	1.465 74	65.4	1.517 53	69.4	1.570 72	73.4	1.625 16	77.4	1.680 74
61.5	1.467 02	65.5	1.518 84	69.5	1.572 06	73.5	1.626 54	77.5	1.682 14
61.6	1.468 29	65.6	1.520 16	69.6	1.573 41	73.6	1.627 91	77.6	1.683 55
61.7	1.469 57	65.7	1.521 47	69.7	1.574 76	73.7	1.629 29	77.7	1.684 95
61.8	1.470 85	65.8	1.522 79	69.8	1.576 11	73.8	1.630 67	77.8	1.686 36
61.9	1.472 13	65.9	1.524 10	69.9	1.577 45	73.9	1.632 05	77.9	1.687 76
62.0	1.473 41	66.0	1.525 42	70.0	1.578 81	74.0	1.633 43	78.0	1.689 17
62.1	1.474 70	66.1	1.526 74	70.1	1.580 16	74.1	1.634 81	78.1	1.690 58
62.2	1.475 98	66.2	1.528 06	70.2	1.581 51	74.2	1.636 19	78.2	1.691 98
62.3	1.477 26	66.3	1.529 38	70.3	1.582 86	74.3	1.637 57	78.3	1.693 39
62.4	1.478 55	66.4	1.530 70	70.4	1.584 21	74.4	1.638 95	78.4	1.694 80
62.5	1.479 84	66.5	1.532 02	70.5	1.585 57	74.5	1.640 34	78.5	1.696 21
62.6	1.481 12	66.6	1.533 35	70.6	1.586 92	74.6	1.641 72	78.6	1.697 62
62.7	1.482 41	66.7	1.534 67	70.7	1.588 28	74.7	1.643 10	78.7	1.699 03
62.8	1.483 70	66.8	1.535 99	70.8	1.589 63	74.8	1.644 49	78.8	1.700 44
62.9	1.484 99	66.9	1.537 32	70.9	1.590 99	74.9	1.645 88	78.9	1.701 85
63.0	1.486 28	67.0	1.538 64	71.0	1.592 35	75.0	1.647 26	79.0	1.703 27
63.1	1.487 57	67.1	1.539 97	71.1	1.593 71	75.1	1.648 65	79.1	1.704 68
63.2	1.488 86	67.2	1.541 30	71.2	1.595 07	75.2	1.650 04	79.2	1.706 09
63.3	1.490 16	67.3	1.542 63	71.3	1.596 43	75.3	1.651 43	79.3	1.707 51
63.4	1.491 45	67.4	1.543 96	71.4	1.597 79	75.4	1.652 82	79.4	1.708 92
63.5	1.492 75	67.5	1.545 29	71.5	1.599 15	75.5	1.654 21	79.5	1.710 34
63.6	1.494 04	67.6	1.546 62	71.6	1.600 51	75.6	1.655 60	79.6	1.711 75
63.7	1.495 34	67.7	1.547 95	71.7	1.601 88	75.7	1.656 99	79.7	1.713 17
63.8	1.496 64	67.8	1.549 28	71.8	1.603 24	75.8	1.658 38	79.8	1.714 59
63.9	1.497 94	67.9	1.550 62	71.9	1.604 60	75.9	1.659 77	79.9	1.716 01
64.0	1.499 24	68.0	1.551 95	72.0	1.605 97	76.0	1.661 17	80.0	1.717 43

Table for obtaining roll angle ε of involute generated from a base circle of diameter D_b at diameter D_x. Roll angle ε is given in terms of the ratio D_x/D_b
(Continued)

ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b	ε Deg	D_x/D_b
80.1	1.718 85	84.1	1.776 09	88.1	1.834 21	92.1	1.893 12	96.1	1.952 74
80.2	1.720 26	84.2	1.777 53	88.2	1.835 67	92.2	1.894 60	96.2	1.954 24
80.3	1.721 69	84.3	1.778 98	88.3	1.837 14	92.3	1.896 08	96.3	1.955 74
80.4	1.723 11	84.4	1.780 42	88.4	1.838 60	92.4	1.897 56	96.4	1.957 24
80.5	1.724 53	84.5	1.781 87	88.5	1.840 07	92.5	1.899 05	96.5	1.958 74
80.6	1.725 95	84.6	1.783 31	88.6	1.841 53	92.6	1.900 53	96.6	1.960 24
80.7	1.727 37	84.7	1.784 76	88.7	1.843 00	92.7	1.902 02	96.7	1.961 75
80.8	1.728 80	84.8	1.786 20	88.8	1.844 46	92.8	1.903 50	96.8	1.963 25
80.9	1.730 22	84.9	1.787 65	88.9	1.845 93	92.9	1.904 99	96.9	1.964 75
81.0	1.731 65	85.0	1.789 10	89.0	1.847 40	93.0	1.906 47	97.0	1.966 25
81.1	1.733 07	85.1	1.790 54	89.1	1.848 86	93.1	1.907 96	97.1	1.967 75
81.2	1.734 50	85.2	1.791 99	89.2	1.850 33	93.2	1.909 44	97.2	1.969 26
81.3	1.735 92	85.3	1.793 44	89.3	1.851 80	93.3	1.910 93	97.3	1.970 76
81.4	1.737 35	85.4	1.794 89	89.4	1.853 27	93.4	1.912 42	97.4	1.972 27
81.5	1.738 78	85.5	1.796 34	89.5	1.854 74	93.5	1.913 91	97.5	1.973 77
81.6	1.740 20	85.6	1.797 79	89.6	1.856 21	93.6	1.915 40	97.6	1.975 28
81.7	1.741 63	85.7	1.799 24	89.7	1.857 68	93.7	1.916 88	97.7	1.976 78
81.8	1.743 06	85.8	1.800 69	89.8	1.859 15	93.8	1.918 37	97.8	1.978 29
81.9	1.744 49	85.9	1.802 14	89.9	1.860 62	93.9	1.919 86	97.9	1.979 79
82.0	1.745 92	86.0	1.803 59	90.0	1.862 10	94.0	1.921 35	98.0	1.981 30
82.1	1.747 35	86.1	1.805 05	90.1	1.863 57	94.1	1.922 84	98.1	1.982 81
82.2	1.748 79	86.2	1.806 50	90.2	1.865 04	94.2	1.924 34	98.2	1.984 31
82.3	1.750 22	86.3	1.807 95	90.3	1.866 51	94.3	1.925 83	98.3	1.985 82
82.4	1.751 65	86.4	1.809 41	90.4	1.867 99	94.4	1.927 32	98.4	1.987 33
82.5	1.753 08	86.5	1.810 86	90.5	1.869 46	94.5	1.928 81	98.5	1.988 84
82.6	1.754 52	86.6	1.812 32	90.6	1.870 94	94.6	1.930 30	98.6	1.990 35
82.7	1.755 95	86.7	1.813 77	90.7	1.872 41	94.7	1.931 80	98.7	1.991 86
82.8	1.757 39	86.8	1.815 23	90.8	1.873 89	94.8	1.933 29	98.8	1.993 37
82.9	1.758 82	86.9	1.816 69	90.9	1.875 37	94.9	1.934 78	98.9	1.994 88
83.0	1.760 26	87.0	1.818 14	91.0	1.876 84	95.0	1.936 28	99.0	1.996 39
83.1	1.761 69	87.1	1.819 60	91.1	1.878 32	95.1	1.937 77	99.1	1.997 90
83.2	1.763 13	87.2	1.821 06	91.2	1.879 80	95.2	1.939 27	99.2	1.999 41
83.3	1.764 57	87.3	1.822 52	91.3	1.881 28	95.3	1.940 76	99.3	2.000 92
83.4	1.766 01	87.4	1.823 98	91.4	1.882 75	95.4	1.942 26	99.4	2.002 43
83.5	1.767 45	87.5	1.825 44	91.5	1.884 23	95.5	1.943 76	99.5	2.003 94
83.6	1.768 89	87.6	1.826 90	91.6	1.885 71	95.6	1.945 25	99.6	2.005 46
83.7	1.770 33	87.7	1.828 36	91.7	1.887 19	95.7	1.946 75	99.7	2.006 97
83.8	1.771 77	87.8	1.829 82	91.8	1.888 67	95.8	1.948 25	99.8	2.008 48
83.9	1.773 21	87.9	1.831 28	91.9	1.890 15	95.9	1.949 75	99.9	2.010 00
84.0	1.774 65	88.0	1.832 75	92.0	1.891 63	96.0	1.951 24	100.0	2.011 51

Precision Machine Tool Ways—

Hand Scrape? *Machine Grind?*

LAURENCE W. COLLINS, Jr., Associate Editor

Big toolroom-quality machines with machine ground ways are meeting acceptance. Accuracy of ground ways is at least the equal of hand scraping. Cost savings are spectacular

ALL BEARING WAYS on a Lees-Bradner 8- by 102-inch precision spline-hobbing machine, recently delivered to Giddings & Lewis, were completely finished by machine grinding. There was no hand scraping on the bed (seen in Fig. 1), the two carriages, the column, or the slide (Fig. 2).

There has been an ingrained belief that there would never be a successful substitute for hand scraping to get the accuracy in way type bearings that machine tools must have to be reliably precise. The tolerance of accuracy on the 8- by 102-inch spline hobber is 0.0005 inch maximum in way alignment and flatness, and a maximum of 0.0005 inch on bed twist (a corner-to-corner diagonal), Fig. 3.

The way grinder used on the Lees-Bradner machines is a large, heavy-duty Hill-Acme unit with a planer type bed and bridge columns. Mounted on the horizontal rail are two heavy-duty Pope grinding units. One wheel-head does all horizontal grinding as seen in Fig. 4. The other spindle, shown in Fig. 5, can be tilted for the dovetails, the sides of the T-slot, the thrust and gib sides, and the two undersurfaces on which ride the slide hold-down straps. The whole machine is unusually massive, and has an over-all accuracy of 0.0005 inch to match that specified for the spline hobbers and thread millers whose beds it is designed to finish-grind. For example, the flat-way grinding unit is actually a Pope wheel-head of the type normally used on centerless and cylindrical grinding machines. It is belt-driven and has a flanged cartridge and has a

Fig. 1. Large precision spline hobber with ways completely machine ground. In center foreground is Centro-Matic metering device that feeds lubricant under pressure to the ways.

Fig. 2. Hand scraping by cut-and-try methods is replaced by machine grinding which offers equal accuracy plus savings in production time.

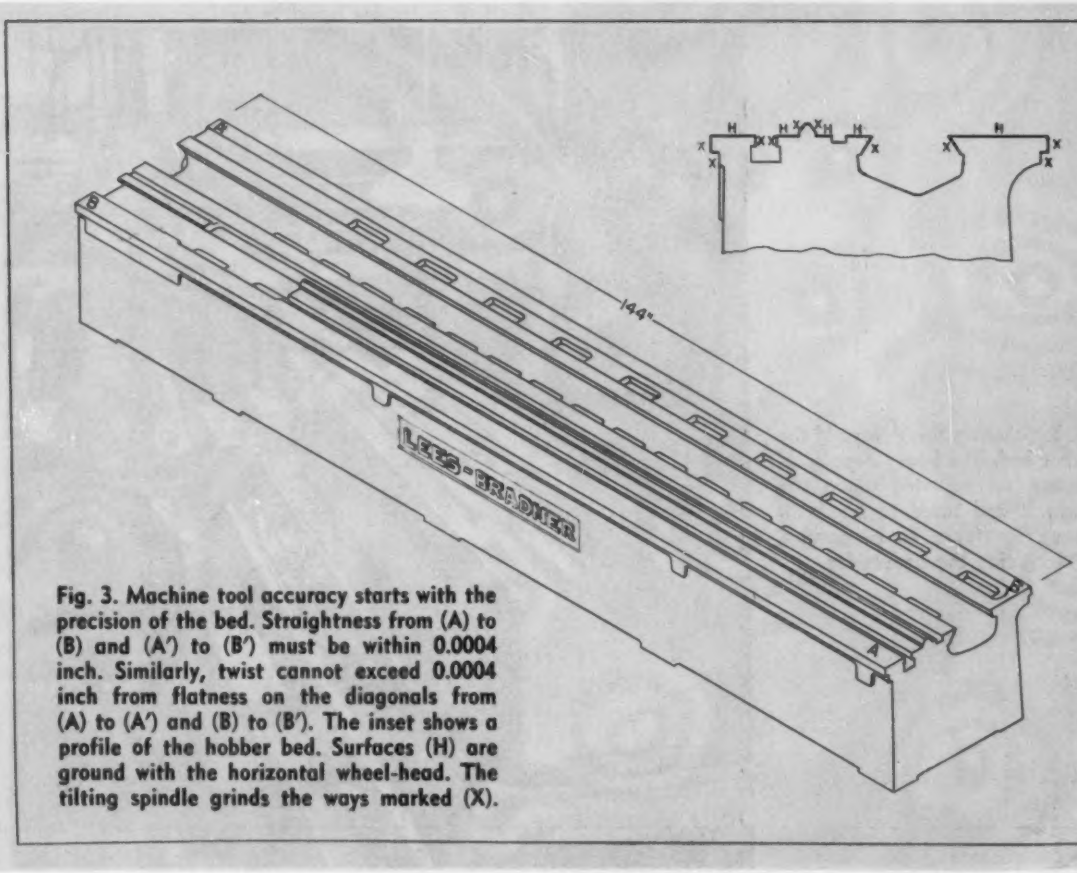


Fig. 3. Machine tool accuracy starts with the precision of the bed. Straightness from (A) to (B) and (A′) to (B′) must be within 0.0004 inch. Similarly, twist cannot exceed 0.0004 inch from flatness on the diagonals from (A) to (A′) and (B) to (B′). The inset shows a profile of the hobber bed. Surfaces (H) are ground with the horizontal wheel-head. The tilting spindle grinds the ways marked (X).

Fig. 4. Hobber bed and chip-pan assembly is clamped to the way grinder's table for finishing of all way bearing surfaces in a single setup. Shown at work is the heavy Pope wheel-head grinding one of the horizontal surfaces.

Fig. 5. Grinding the V-ways of the hobber bed. The heavy Pope spindle can be adjusted along the cross-rail and tilted to reach all the way surfaces to be ground, including the undersides.

total shaft runout of 50 millionths of an inch.

The heavy, motorized tilting spindle, used for making cuts on all but the flat ways, has a special extension arbor permitting it to grind accurately in comparatively inaccessible spots. Spindle speed is 3600 rpm and the unit is rated at 7 1/2 hp.

A typical production cycle for a machine bed starts with planing of the casting as received from the foundry. All surfaces to be ground are planed down to rough dimensions, leaving 0.015 to 0.016 inch for cleanup. Then, after a stress-relief operation on the whole bed casting, the ways are flame-hardened. The first grinding step is to finish the pads on the chip pan. Then the feet of the bed are ground on the bottom. Formerly both of these sets of surfaces were hand scraped.

Next, the chip pan is bolted to the bed feet and this assembly is clamped down to the grinder table, as a unit, for way grinding. The flat ways are ground to rough dimensions, using the horizontal head; then, using the swivel grinding head, the dovetail, verticals, and underside cuts are roughed to equalize stresses. Finish grinding proceeds in the same order, using finer wheels and light cuts. The last grinding cuts made on all surfaces, except horizontal ways, give the way surfaces the equivalent of hand scraping in their ability to hold lubricating oil. Here the Pope spindle is fitted with a cupped wheel which is coarse and somewhat hard. The result is a light crisscross scoring of the surface that contrasts with the fine even grind of the horizontal way surfaces, Fig. 6. This surface has been named the "cat's-eye finish" by Hill-Acme personnel. After grinding, the whole bed is carefully inspected for all dimensions, squareness, and twist (Fig. 7), using a variety of indicators, some on magnetic bases (Fig. 8).

To many readers a fair and obvious question will be suggested as to how to get slip between such hard, finely ground flat bearing surfaces. By conventional methods machine ways are hand scraped and finally dressed off by a decorative pattern called "spotting" that holds oil. The hand spotting operation is considered an art. To spot an 8- by 72-inch spline-hobber bed takes a team of two men about four hours. One man wields the scraping tool while the other guides him with a fixture. The spotting of the bed ways is decorative and is thought to suspend oil in a film that provides slip. The ways consequently wear less rapidly and the machine's long-run accuracy is extended. The spotted surface, over the years, has become a symbol signifying accuracy seldom found elsewhere.

On horizontal ways of the latest Lees-Bradner machines, the spotting and evidence of hand

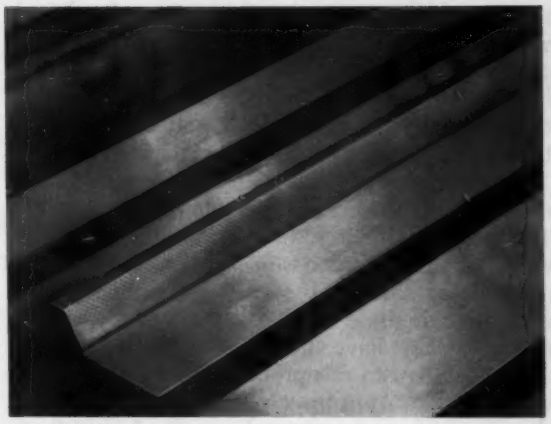
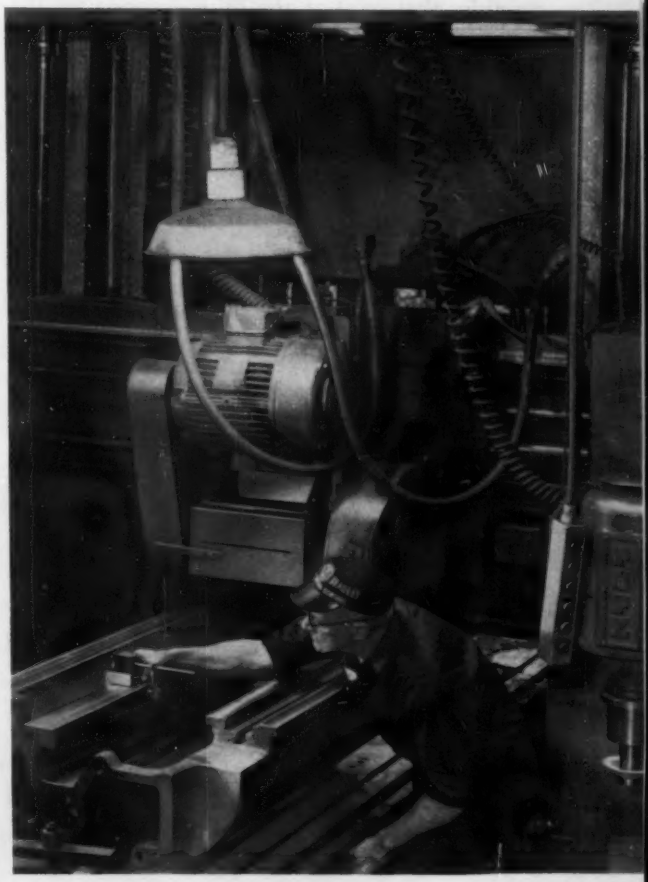


Fig. 6. Cat's-eye finish ground on the V-ways contrasts dramatically with the uniformly horizontal surfaces. The scoring holds oil for improved slip. Lubricant delivered under pressure provides bearing slip.

Fig. 7. The grinding machine table is so accurate that it is used as a surface plate for gaging. Here the operator is checking the distance between the surfaces of a machine tool column.



scraping are absent. Instead, the flame-hardened way surfaces resemble the finely ground faces of stamping dies. As a matter of fact, they are flame-hardened to 50-52 Rockwell C, and impractical to hand scrape. So flat, smooth, and hard are they that a bearing between two such mating surfaces "wrings together," like a pair of gage-blocks, making the moving member almost immovable. The problem, thus is that grinding makes the ways *too* flat and *too* smooth for conventional methods of shifting the carriage and tailstock, even though some of the way bearing surfaces of the carriage have the cat's-eye finish.

The solution to this problem lies in a new flat-bearing lubricating principle. Oil for lubricating the way surfaces is pumped into the bearings at 40 psi from a Lincoln (St. Louis, Mo.) Centro-Matic system. A sealed plastic reservoir containing way lubricating oil is mounted at a convenient location on the machine base. Compressed air, controlled to 40 psi, is introduced at the top of the vessel. A system of rigid and flexible tubing leads the oil to all bearing surfaces. The way surfaces on the bottom of the carriage have holes leading into the oil system. Thus, the carriage literally floats on clean oil that is pumped to the bearings. The pressure on the oil is adjusted so carefully that most of the oil is trapped by the very flatness of the ways. A tiny amount of oil is constantly "bleeding" through the bearing. This is enough to float the carriage. At the same time, any chips or other foreign matter on a way surface is pushed away and cannot get into the bearing surface. In this way, scoring and wear are kept to a minimum.

From a machine tool builder's production standpoint, the company notes seven major advantages for grinding over hand scraping. The method assures consistency of way accuracy; permits the use of integral, hardened ways; provides a uniform oil film between way bearing surfaces; gets enthusiastic user acceptance; reduces manufacturing costs; shortens lead time; and improves delivery predictability.

Fig. 8. Angularity between ground surfaces of a machine column is checked for accuracy. The change from hand scraping to machine grinding produces machine components of such precise uniformity that expensive fitting by hand scraping is no longer required on the assembly floor.

Below is a table of typical Lees-Bradner labor costs, comparing hand scraping with grinding machine ways as of December, 1959.

Further savings are also realized when ground beds, carriages, slides, and columns reach the assembly floor. Because all ways are made to blueprint tolerances, there is no need for slow, expensive hand refitting of the bearing surfaces at assembly; therefore costs are again reduced and lead time is shorter.

Because only one operator and one machine are involved in the finishing of ways, as compared to the arrangements for hand scraping by groups of manual operators, it is now much simpler to estimate the time that will be consumed for delivery of an order, a decided help to the sales department.

		Hours	Rate	Total Labor Cost	Saving
8- by 72-inch bed	Scrape	96.0	2.35	$1014.72	
	Grind	22.5	2.79	282.37	$732.35
Slide	Scrape	12.0	2.35	126.84	
	Grind	.8	2.79	10.04	116.80
Carriage	Scrape	25.0	2.35	264.25	
	Grind	6.0	2.79	75.30	188.95

STEEL—
the ASM Metal Show's New Look

Week-long question-and-answer session on all kinds of metal problems will enhance Exposition for visitors

"BACK TO FUNDAMENTALS" expresses the intent of the Forty-Second Annual National Metal Show and Congress of the American Society for Metals. This event will be staged in Philadelphia, October 17 to 21. The 1960 exposition, at the Philadelphia Trade and Convention Center, will concentrate attention on education and answering the technical and metal engineering questions of visitors.

A new show feature, the Steel Arena, is allocated to decorative groupings of steel forms and parts in an almost endless variety of steel-at-work applications for industry and consumers. Unlike recent metal shows, this year's proprietary displays will be restricted to eleven major engineering categories of the metal industry, creating an exposition whose atmosphere focuses attention on the technical aspects of metals engineering.

The eleven groupings are: ferrous metals; nonferrous metals; related engineering materials; nuclear materials and equipment; tool materials; industrial heating equipment and supplies; cleaning equipment and supplies; welding and joining equipment and supplies; testing, inspection, and control equipment and supplies; metals production, casting equipment and supplies; parts, forms, and shapes for design and application.

The activities in Philadelphia will include the National Metal Congress, a week long schedule of technical papers, seminars, conferences, symposia, and panel discussions on advanced topics in metallurgy and related technical and engineering subjects. There will be an innovation at the Metal Show itself, intended to make technical and engineering information more accessible to visitors. With the cooperation of the American Iron and Steel Institute, the ASM will have a panel of nearly 200 technical, marketing, and sales experts available in the sixteen company displays to answer technical queries. Participation of the AISI members will be limited to the Steel Arena.

With this year's show theme centered on steel, one of the most interesting sessions of the metal congress promises to be a symposium for steel users at 2 P.M. Tuesday, October 18. This symposium has for its topic, "Stainless Steels." The following technical papers will be presented: "What is Stainless Steel," by John J. B. Rutherford, chief metallurgist, Tubular Products Division, Babcock & Wilcox Co.; "What to Expect of Stainless Steels," by K. A. Matticks, manager, customer technical service, Crucible Steel Company of America; and "Special Stainless Steels" by Adolph J. Lena, manager, Basic Research Department, Allegheny Ludlum Steel Corporation.

A panel discussion on stainless-steel fabrication will follow the reading of the technical papers. The panel moderator will be R. B. Gunia, manager, stainless steel metallurgy, United States Steel Corporation. The various phases of fabrication will be represented on the panel as follows: joining, G. E. Linnert, supervising research metallurgist, Armco Steel Corporation; machining, Peter Leckie-Ewing, manager, technical services, Latrobe Steel Co.; forming, W. L. Keene, director of research and metallurgy, Superior Steel Division, Copperweld Steel Co.; heat-treating, B. T. Lanphier, manager of research, Carpenter Steel Co.; and cleaning and finishing, S. P. Odar, assistant plant metallurgist, Enduro Metallurgical Laboratory, Republic Steel Corporation.

At the annual dinner of the ASM several of the society's major awards will be presented. Leading metallographers from all over the world will present over 300 examples of their finest work in the ASM Metallographic exhibit, competing in fourteen classifications of this science.

The featured speaker at the Fifth Annual Awards luncheon of the ASM will be Edward G. Budd, president of The Budd Company. He will be awarded the society's Distinguished Life Membership at the conclusion of his address. The final day of the metal congress will observe Young Engineers Day. Future engineers from the Philadelphia area have been invited to join the society's twenty-five-year members at the Distinguished Service Luncheon of the Society. The principal address on this occasion will be delivered by Stanley H. Norwood, vice-president, Union Carbide Metals Co.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

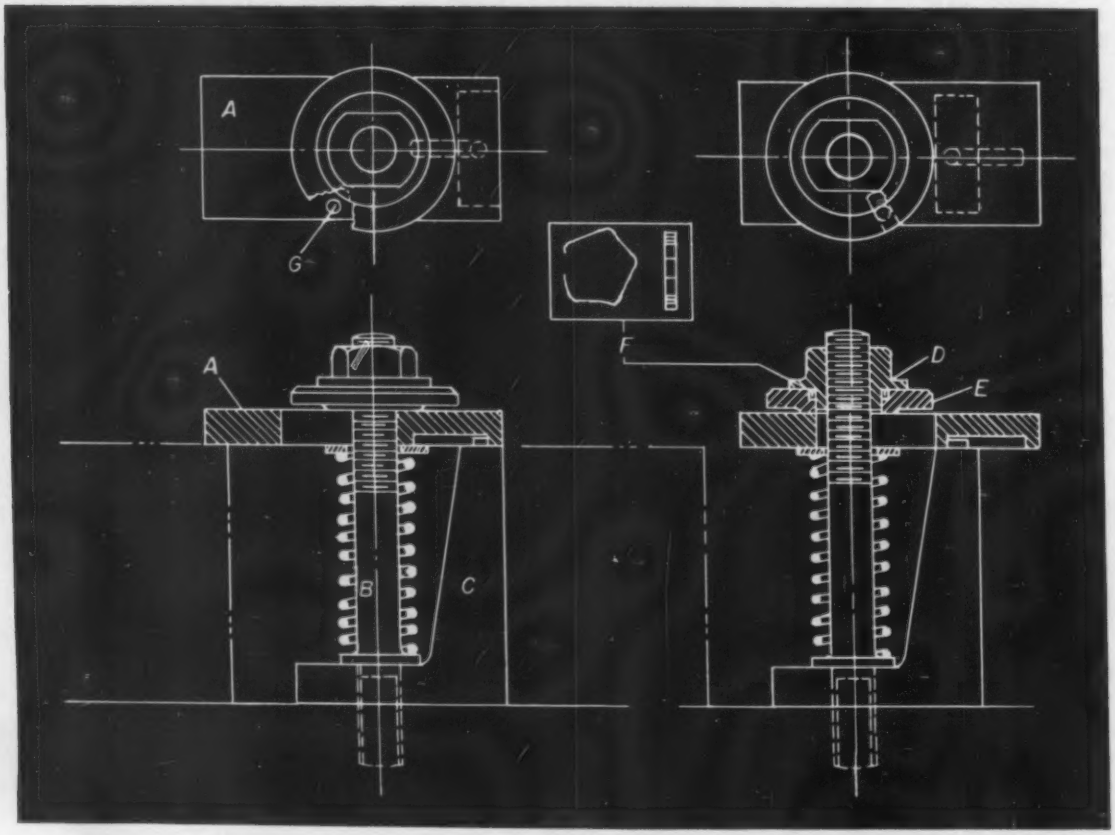
Self-Positioning Strap Clamp

A. K. Das, Calcutta, India

A strap clamp has been constructed that can be called self-positioning in action. It advances over the edge of the work-piece when tightened, and backs away when clamping pressure is released. Construction and operation of this clamp are shown in the accompanying illustration. Although originally designed for holding large gear blanks while internal teeth were being cut, its simplicity should give it a universal application.

Slotted clamp plate *A* is supported over stud *B* by a standard coil spring and washer. A pin on top of support block *C* engages a 1/4-inch wide (for this application) lengthwise groove in the underside of the clamp-plate heel. Locking the clamp plate on the stud are special nut and washer *D* and *E*, respectively.

Nut, washer, and plate are linked together to provide self-positioning feature for this strap clamp. Approximately one-half turn in either direction is all that is needed to position and lock the clamp, or vice versa.



A high degree of friction is maintained between the nut and washer by a corrugated friction ring *F* which is formed from a flat piece of spring steel. This ring is seated in a recess in the washer and binds against the bottom surface of the nut. The washer, in turn, is linked to the clamp plate. A positioning pin *G* protrudes from the top surface of the clamp plate and engages an open-end groove in the underside of the washer.

When clamping a work-piece to a machine table, nut *D* is turned clockwise with a wrench. Because of friction ring *F*, washer *E* turns as one unit with the nut and (by means of pin *G*) advances clamp plate *A* into locking position as shown at the left in the illustration. Only one-quarter turn of the nut is necessary to bring the plate over the work-piece. Forward movement of the plate is then halted by bottoming of the pin on support block *C* in its mating groove. Continued tightening of the nut, which will be about another one-quarter turn, serves to apply the necessary clamping pressure to the work.

To unclamp the part, the nut is turned counterclockwise. The first one-quarter turn releases the toe of the clamp plate, thus eliminating friction between it and the work-piece. Further turning of the nut causes washer *E* to move with it, thereby pushing the clamp plate back to its opposite extreme position as seen at the right in the illustration. Any additional movement of the nut in the same direction will allow the plate to rise through the influence of the coil spring. Actually, only one-half turn of the nut in either direction is needed to clamp or unclamp the work-piece.

"Quick and Easy" Corner-Rounding Die

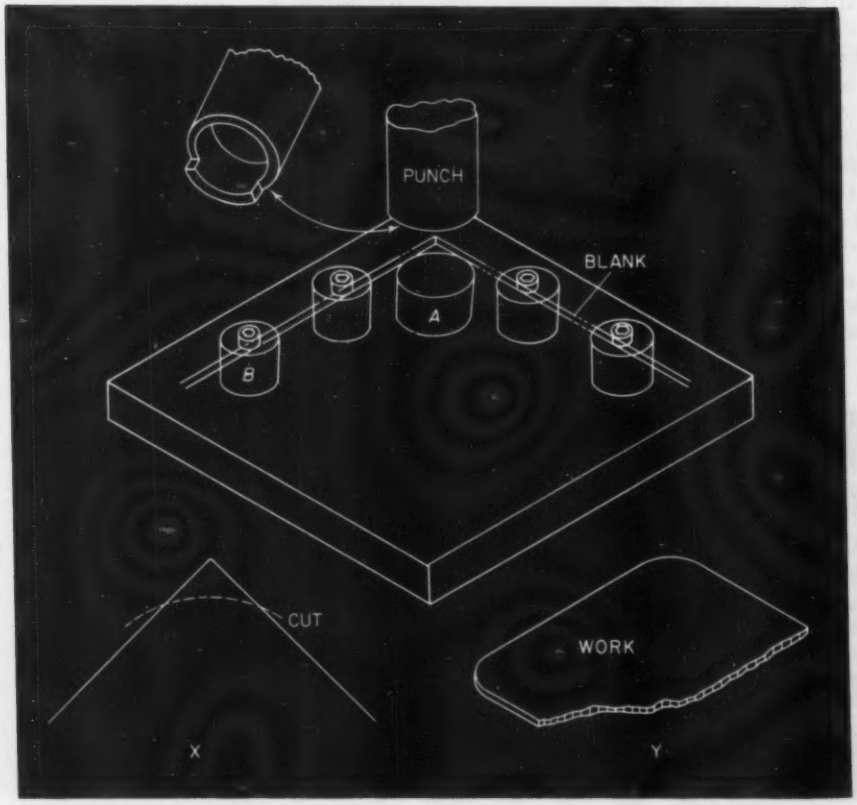
CLINT MCLAUGHLIN, Rockaway, N. Y.

A simple die for cutting round corners on steel sheets that have been blanked square is here shown. The die consists primarily of a steel plate on which are mounted a punch pilot *A* and four plugs *B* with locating screws on top. The punch pilot has a shoulder and is assembled in a hole that has been drilled and reamed in the plate.

The four plugs are machined to the same length as the pilot and secured to the plate by the locating screws. The plugs support the work with the edges of the work banked against the cylindrical screw heads for proper location.

The punch is bored out to fit the pilot plug and then milled off on the bottom end so that a 90-degree projection remains as illustrated. This projection does the actual cutting.

The locating screws should be so positioned that the cut is not quite tangent to the sides of the work, as seen in View *X*.



Convenient die designed for cutting rounded corners on metal sheets.

Low-Cost Counterboring Done with Drill Press

H. J. GERBER, Stillwater, Okla.

Exact depth of counterboring cuts is assured in the shortest time through the use of a novel arrangement using a drill press for short-run jobs. A flange is turned for the shank of the counterboring tool. After press-fitting to the shank, the relieved underside of the flange is finish-turned.

In contact with this lower surface is the anvil of a dial indicator which is mounted on a bracket stand as shown in the illustration. Using this arrangement, the operator watches and accurately controls the depth of cut by observing the indicator as the counterbore feeds into the bore.

Flange and indicator arrangement is simple and inexpensive for short runs. It obviates the frequent need for stopping the machine and withdrawing the tool to measure depth.

Simple Gage for Length Dimension

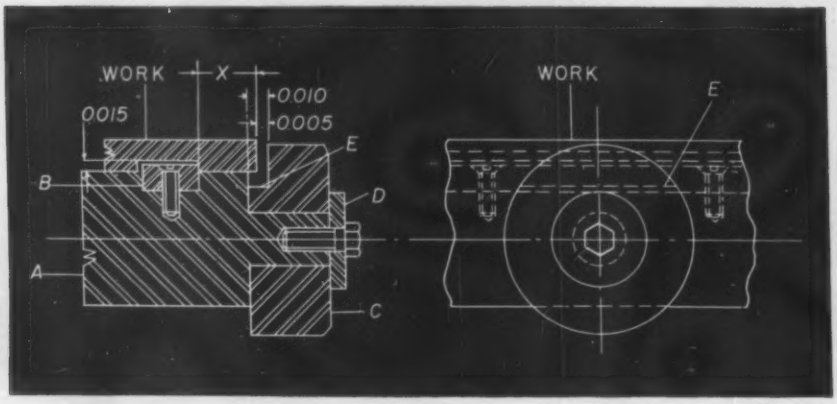
CLIFF BOSSMANN, Dayton, Ohio

Recently it was necessary to design a gage for checking distance *X* (see accompanying illustration) from one side of a milled groove in a part to an adjacent end of the work. The dimension had to be held within ±0.005 inch.

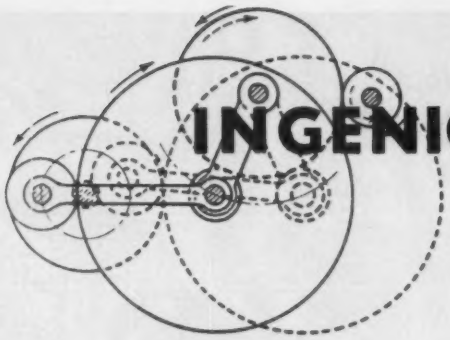
A simple gage was designed with a base *A* that has a flat top surface on which the work-piece can be firmly placed. A hardened and ground insert *B* provides a means of registering the critical side of the work groove. The distance from this point of registry to a shoulder on the right-hand end of the gage base is equal to the lower limit of dimension *X*.

Knurled collar *C* has a slip fit on a shank at the end of base *A* and also a slip fit between the shoulder of the base and collar *D*. Step *E*, 0.010 inch wide, was ground across the upper portion of the collar on the side adjacent to the base, this dimension being equal to the permissible tolerance of dimension *X*.

In an inspection, if it is possible to lay the work-piece on the gage as shown, it is indicative that dimension *X* is within the maximum limit. Then knob *C* is swiveled, and if it is impossible to turn the knob around completely because of step *E* contacting the end of the work, it is indicated that the work is longer than the minimum limit of dimension *X*. Parts that are too long cannot be loaded on the gage because of interference with the face of collar *C*. Conversely, parts that are too short are indicated when the knob can be rotated without interference.



Simple "Go" and "Not Go" gage for accurately checking the distance from a groove to the end of a work-piece.



INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Simple Device Reciprocates Rotating Printing Roll

J. Boas Popper

An arrangement was required to spread ink evenly between two revolving printing rolls. Although there are many conventional solutions of this problem, the assembly here illustrated accomplishes the desired results with a minimum number of moving parts which can be easily disassembled and cleaned.

Equal distribution of the ink is best obtained by allowing one of the rollers to reciprocate continually in an axial direction during operation. In addition, one roll should be made slightly larger than the other so that the same areas of contact are not repeated on each revolution of the rolls.

The reciprocating mechanism, which is an integral part of the printing device seen in Fig. 1, is shown in detail in Fig. 2. In the setup, a drive wheel *A* rotates printing roll *B* which, in turn, drives the second printing roll *C*. Roll *A* rotates in antifriction bearings which are held in housings *D* supported freely in slots in machine frame *E*. Members *F* and *G* are leaf-spring segments mounted in diametrically opposed positions on a collar on the shaft of roll *B*. Two collars *H* and *J* are each threaded on one-half of their circumference and relieved on the other half to a diameter less than the minor diameter of the thread. Collars *H* and *J* are threaded right-handed and left-handed, respectively, and are mounted side by side on the shaft support roll *C*. The width of each collar is made equal to the length of the axial stroke to be given roll *C*. The threaded collar and leaf-spring segment assemblies are shown close up in Fig. 3.

As roll *B* revolves, segment *F* enters the thread on collar *H*, moving roll *C* to the right during the period they remain in mesh. Then, as segment *J* is rotated into the meshing position, the unthreaded half of the collar is presented to the segment and the roll remains stationary for a period. Later, segment *F* re-engages collar *H* and continues moving roll *C* to the right. This sequence would continue if the rolls were equal in diameter. However, since roll *C* is slightly larger than roll *B*, segment *G* reaches a position where it comes into contact with the threaded part of collar *J* and moves roll *C* to the left.

The leaf-spring segments are resilient, so that if they hit the crest of the thread, they are pushed aside. Then, because they are straight and the thread is helical, the segments will slip into proper mesh with the thread after roll *B* has rotated a few degrees. Due to

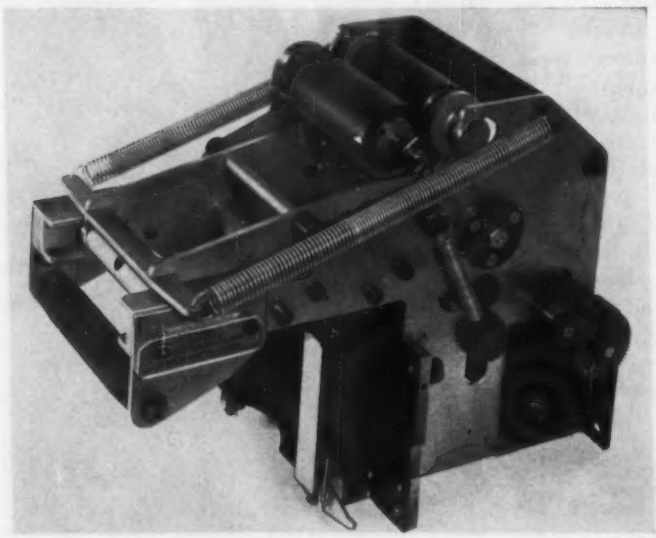


Fig. 1. An arrangement that automatically spreads ink applied to printing rolls is incorporated in this device.

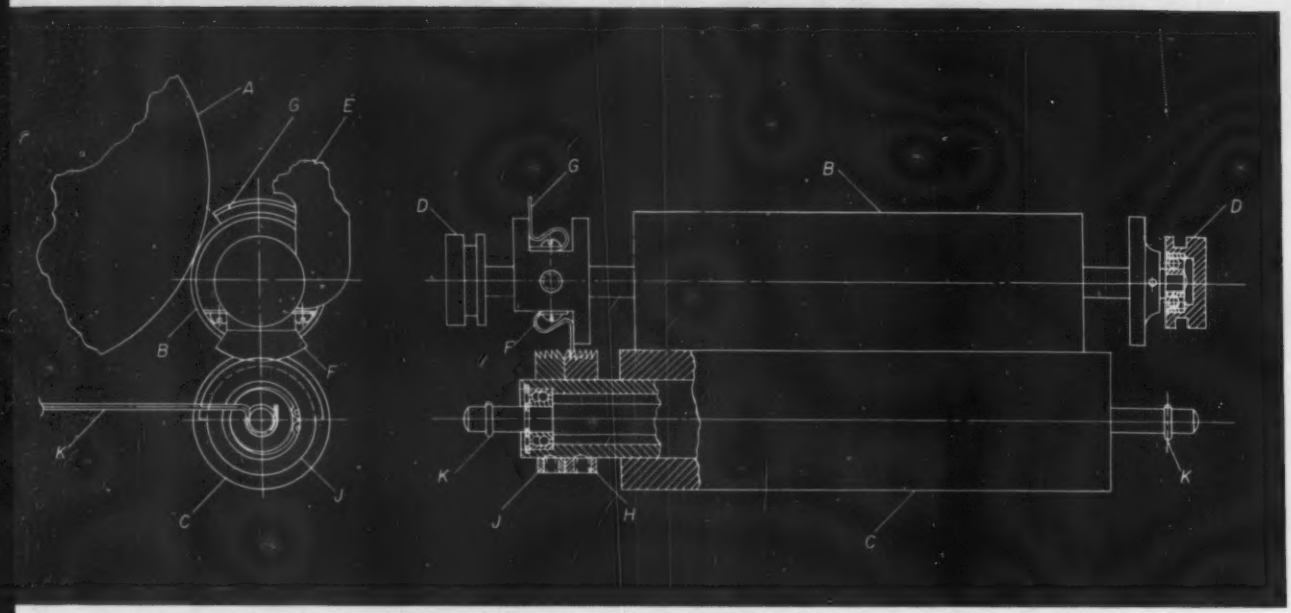


Fig. 2. To spread the ink evenly, roll (C) is reciprocated as it rotates in contact with roll (B). Each stroke is accomplished in short intermittent steps.

the alternating blank and threaded surfaces on collars *H* and *J*, roll *C* is displaced axially in short intermittent strokes. This type of motion is helpful in spreading the ink.

In the particular arrangement shown here, each stroke lasts fourteen revolutions of roll *B*. The ratio of the roll diameters is 15 to 16, and the length of the axial stroke of roll *C* is 3/8 inch or two and one-half times as large as the largest letter to be printed. Each of the collars has an eight-entry thread, the lead of each thread entry measuring 1/2 inch and the pitch, therefore, being 1/16 inch.

The segments displace roll *C* axially about 1/10 ipr (which is a little more than the pitch) in order to assure the entry of the segment into the next thread. Consequently, each segment occupies 70 degrees of arc. The effective axial displacement, therefore, measures 1/16 inch, and six turns of roll *B* are required to move roll *C* 3/8 inch. During each seventh and eighth turn of roll *B*, roll *C* is idle. In operation, the rotational speed of roll *B* is 230 rpm.

Members *K* are two identical hook-shaped springs that hold roll *C* against roll *B* and thus cause roll *B* to press firmly against driving wheel *A*. With this arrangement, the whole assembly can be taken apart simply by removing hooks *K*. It is unnecessary to adjust the mechanism during assembly, since the arrangement will automatically start the correct cycle after it has been in operation a few revolutions.

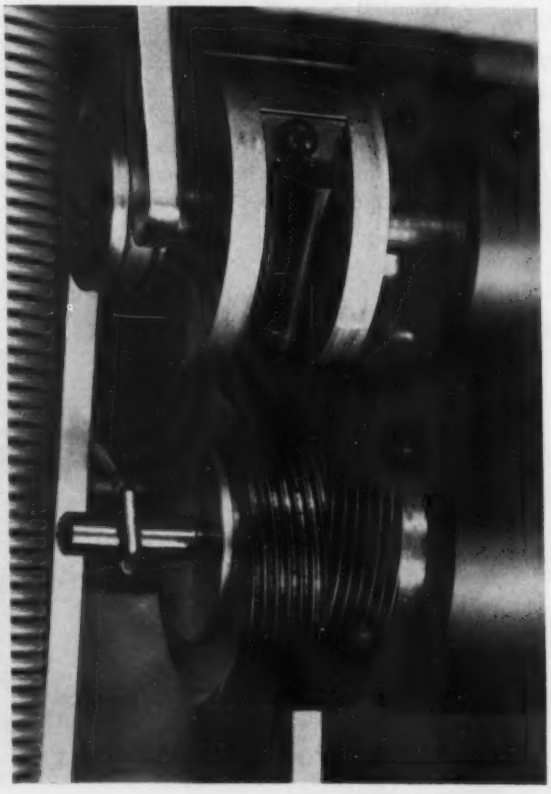


Fig. 3. Here, the half-threaded collars which engage the leaf-spring segments are seen close up. Segment (G) is about to mesh with collar (J).

Down Time Slashed from Console-Monitor

A PRODUCTOGRAPH SYSTEM of industrial control which outmodes the pencil and paper for keeping production data is being introduced by the Farrington Mfg. Co., Needham Heights, Mass. Devised in Germany, the system reduces equipment down time and records all operating activity automatically. It will be made, leased, and serviced in North America by a Farrington subsidiary.

Heart of the Productograph is a console receiving unit, located in a production control center, which can monitor up to 200 machines. A call station at each machine, in conjunction with impulse transmitters (such as micro switches, voltage relays, flow meters, and photoelectric cells), provides instantaneous and continuous communication with the console. Machine operating time, down time, and the causes for down time, are automatically recorded audio-visually on a special graph and on tape.

In addition, the number of items being manufactured, time units, and nominal and actual output are automatically tallied on electrical and linear counters. The linear counters provide a visual record of the quantity of items produced and the production time. Output of the system can be fed directly into accounting equipment to compute costs and payrolls. Incentive payments can be based on the information recorded by the console.

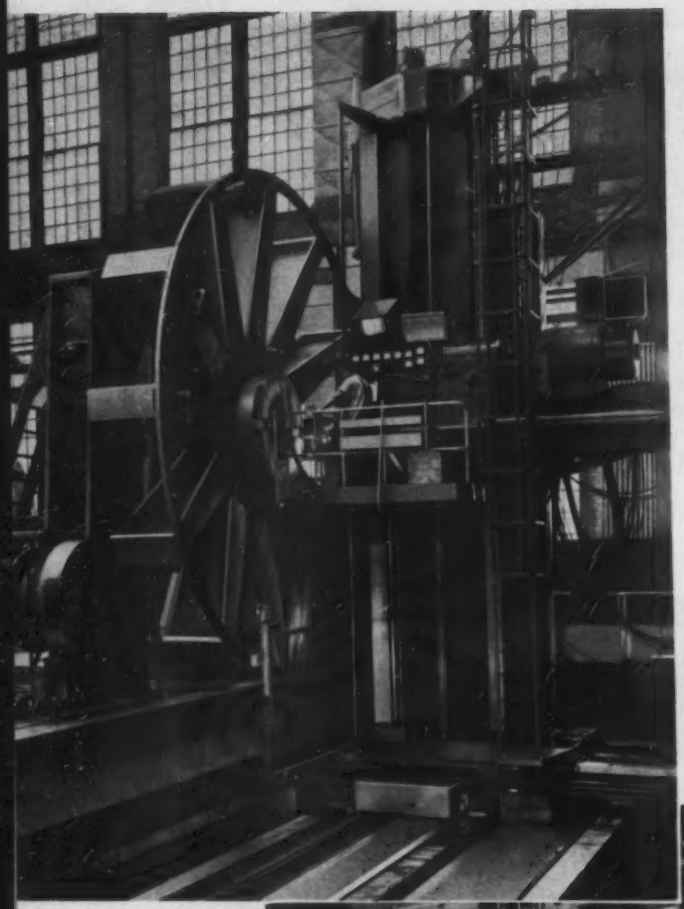
Productograph equipment has been used in Europe in a variety of industries, including metalworking plants, machine tool plants, foundries, and steel mills. There are presently two installations being used in the United States. Both users report a significant reduction in down time (approximately 22 per cent) as a result of a year's experience with the equipment.

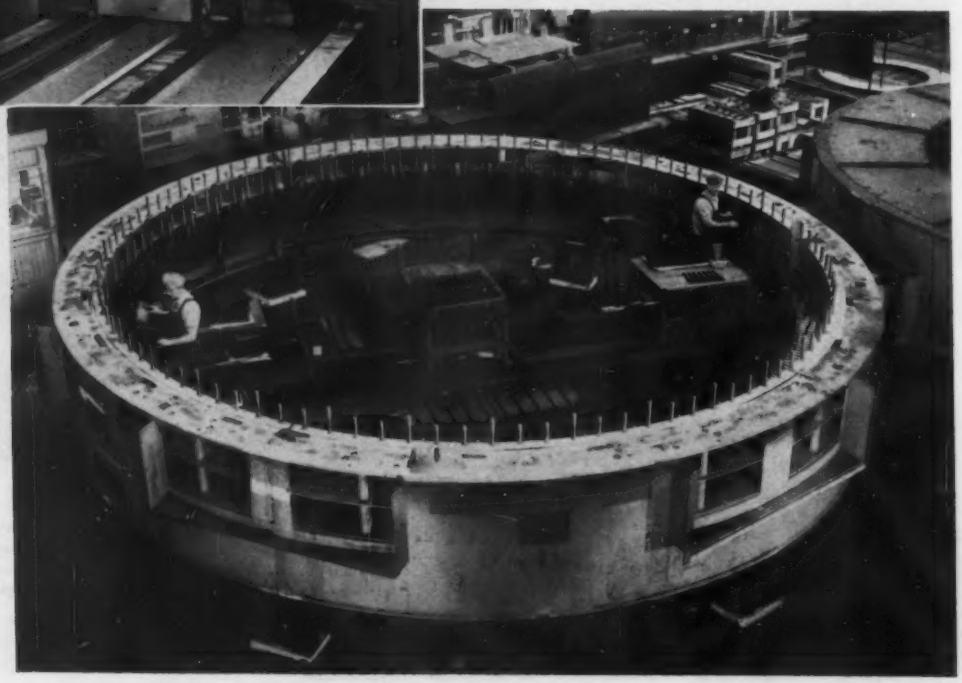
(Right) Two-way telecommunication is provided by a call station for each machine operator in this Productograph installation in the Connecticut Bending and Stamping Works, New Britain, Conn.

(Left) Console includes linear, decade, and running-time counters, totalizers, graphic and tape recorders, detail scriber, lamp fields, speaker and telephone.

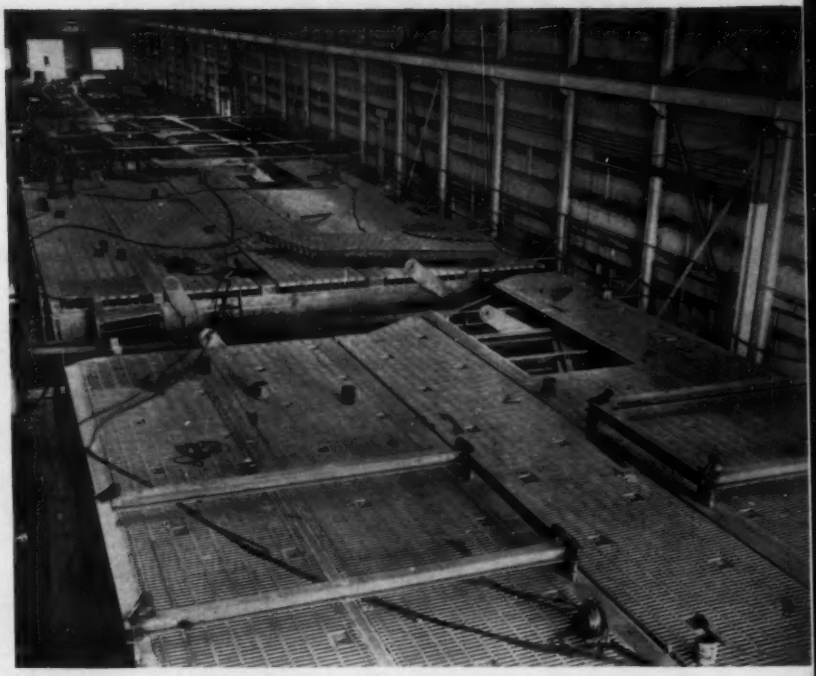
In Shops Around the Country

Camera highlights of some interesting operations performed in various metalworking plants throughout the nation





BIG WHEEL—(Left) Slotting a keyway in one of twelve 43,000-pound rotor spiders at Allis-Chalmers' West Allis (Wis.) Works. The spiders are for 25,000-kva, 37,500-hp synchronous motors for New York State's Niagara River Tuscarora reversible pump-turbine plant, largest of its type in the world. The boring mill has an 8-inch spindle, closed-circuit TV, and an automatic chip-removal system. (Below) Stacking of stator laminations is speeded on a motorized turntable. A long platform borne by the table supports two workers and their materials at opposite ends. Stators are 20 feet in diameter, and have about 45,000 laminations.



PLANE LIFTERS—Three of the four aluminum elevators that will be spotted along the 252-foot-wide flight deck of the USS Enterprise, the first nuclear-powered aircraft carrier and the largest ship in the world, being fabricated at Newport News Shipbuilding and Dry Dock Co. Built of Alcoa 5456 extrusions and plate, the all-welded elevators will permit the use of lighter, less bulky machinery for their operation.

BOTTLE MAKER—At Overmyer Mould Co., Winchester, Ind., LeBlond tracer lathes equipped with constant surface-speed control are contour-turning 58 Rockwell C material to a 10-micro-inch finish. The steel work-pieces, plungers for glass bottle molds, have first been flame-sprayed with a refractory chromium-nickel-boron alloy. The fine finish is obtained with a cast-iron grade carbide.

DEPTH INDICATOR—Drilling liquid metering pumps which dispense beverage concentrates, at Mechanical Products Corporation, Chicago. Extremely small tolerance on hole depth is maintained by an Ames air gage, the stylus of which is supported from the drill press quill, gaging the depth from the top of the drill jig. Preset dial indicator can be seen mounted to the left of the press.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

Thompson Plunge-Matic and Electrolytic Grinders

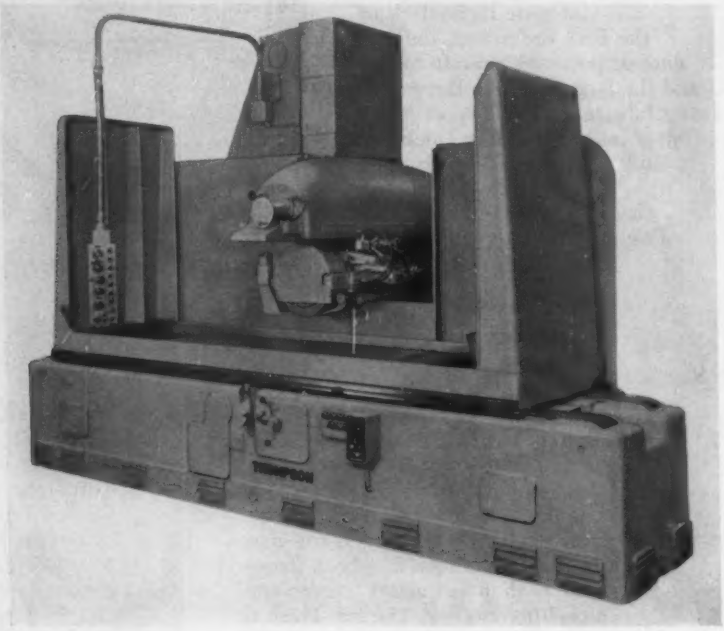
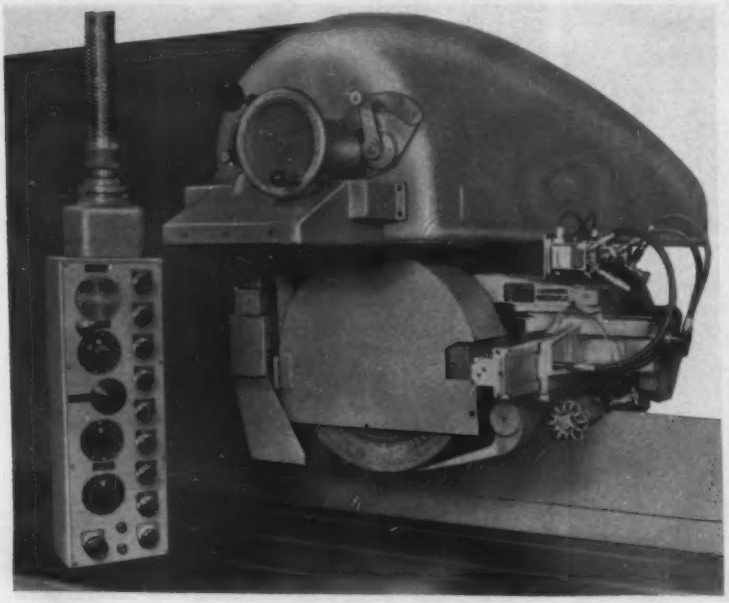


Fig. 1. Thompson Type CX Plunge-Matic grinder with pendant control

Fig. 2. Close-up of Thompson Cybermatic Pendant Control and wheel-truing device of machine shown in Fig. 1



Two newly developed machines, a Plunge-Matic grinder and an electrolytic grinder highlighted the exhibit of the Thompson Grinder Co., Springfield, Ohio, at the recent NMTBA Exposition in Chicago. The Type CX Plunge-Matic 36- by 48- by 72-inch grinder, (see Fig. 1) featured company's Cybermatic Pendant Control. This new type of control completely eliminates the wheel-head elevating handwheel.

All vertical movements of the wheel-head, both automatic and manual, are accomplished effortlessly by dials on the pendant control. For example, the machine can be set for any automatic down feed from 0.0002 to 0.006 inch in increments of 0.0002 inch. The total amount of feed for stock removal from 0 to 1 inch through the 48-inch vertical travel capacity is controlled by the pendant dials. The down feed can be in-

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

itiated at each reversal of the wheel-head on cross-feed as well as on straight plunge-feed from each table reversal by means of the dial controls. Rapid traverse at the rate of 20 ipm for elevation of the grinding wheel is controlled from the pendant, which also includes a push button by means of which the operator can reset the down-feed range.

The automatic wheel-truing device of this machine, for which a preset dressing increment can be selected at the pendant control, is of unusual design. Ordinarily compensation for wheel dressing is manually controlled by a pendant dial, but provision can be made for preselected dressing with automatic compensation. A master stop button is provided in the pendant control.

The grinder is equipped with the exclusive Thompson Hydra-Cool hydraulic system with dual packless table cylinders which provide automatic cushioning at the extremity of the table stroke. All sliding way bearings are lubricated by a separate automatic system. Tape bedway covers are supplied as standard equipment.

A 50-hp, heavy-duty, antifriction bearing wheel-head with a 20- by 6- by 12-inch grinding wheel is regular equipment. This massive grinder is both high powered and very accurate. It can remove cast iron at the rate of 15 cubic inches per minute, or it can grind with precision to tenths of a thousandth of an inch.

A Thompson grinder equipped with a 3000-ampere Anocut electrolytic power unit and an 18-inch diameter by 2 1/8-inch wide, non-diamond metal-bonded grinding wheel was one of several outstanding exhibits of the Thompson Grinder Co., Springfield, Ohio, at the recent NMTBA Show in Chicago. The machine, Fig. 3, is

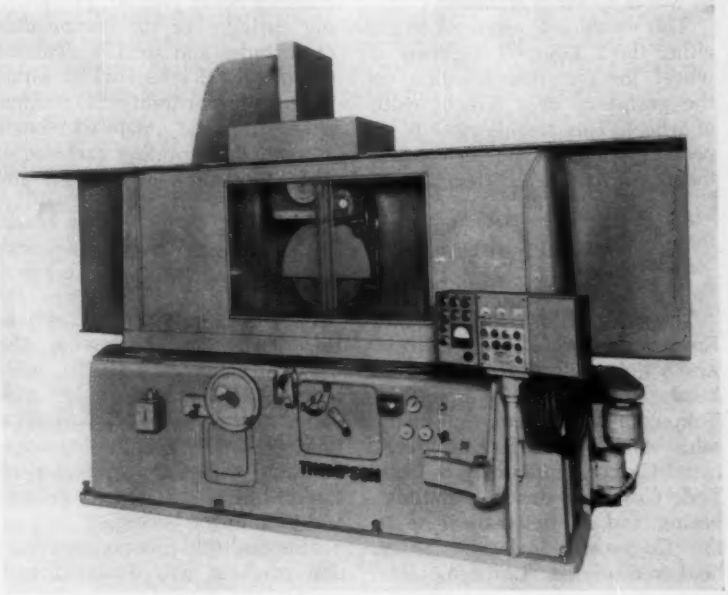
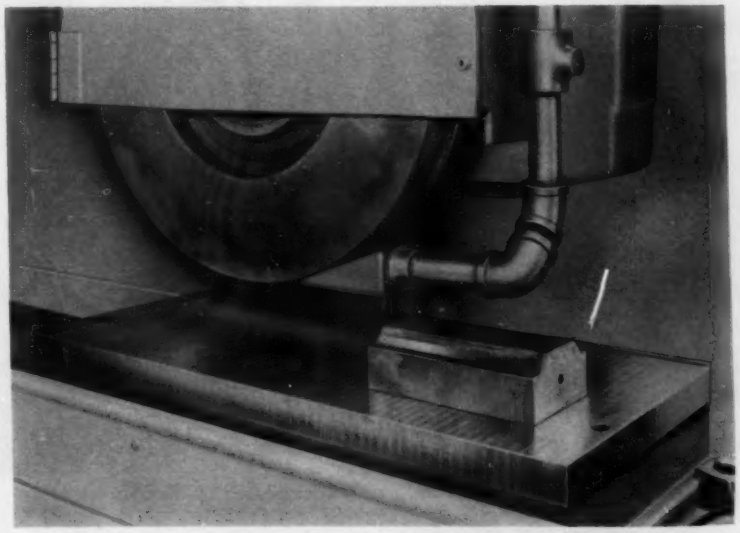


Fig. 3. Thompson electrolytic form and face grinder

Fig. 4. View showing 16-pitch 90-degree serrations on periphery and the diamond dressing block used to form the wheel of machine shown in Fig. 3



equipped with a diamond dressing block or shoe, Fig. 4, for forming 16-pitch 90-degree serrations in the periphery of the 18-inch diameter wheel. A table speed of from 1 inch to 75 feet per minute permits grinding by either electrolytic or conventional methods. A belt-driven spindle designed to permit better selection of wheel speed is standard.

This machine is arranged to use either the 2 1/8-inch thickness of wheel for serration grinding on the periphery or a 5-inch width of wheel. This arrangement is especially useful when sharpening the super tool steels, such as M2 Types 3 and T15. A stock removal rate as high as 0.250 cubic inch of metal per minute can be accomplished with this grinder on the above types of tool steels. The machine will easily grind the so-called exotic materials using the non-diamond, metal-bonded wheel which eliminates any possibility of residual stress in the material being ground. For grinding carbides or the combination of carbides and steel, a diamond metal-bonded wheel which eliminates any possibility of residual stress in the material being ground. For grinding carbides or the combination of carbides and steel, a diamond metal-bonded wheel is used. This grinder is designed to handle grinding wheels in a size range of 10 by 2 by 5 inches up to 20 by 4 by 8 inches.

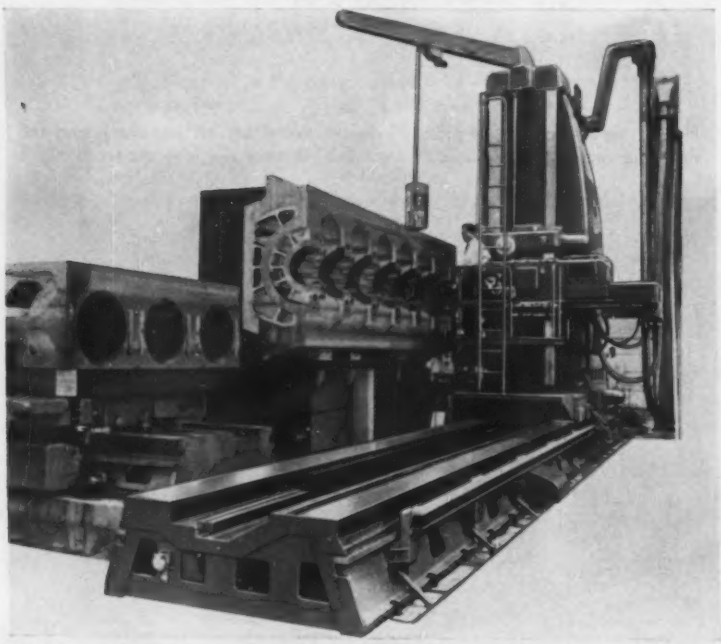
The Thompson Hydra-Cool hydraulic system is standard equipment on this electrolytic grinder. A mist collector as well as enclosing shields in the working area prevent escape of the electrolytic mist and contamination of the surrounding equipment. Particular attention has been paid to the proper selection of materials and epoxy paints and careful fitting to eliminate corrosion.

Circle 565 on Readers' Service Card

Mitsubishi-Innocenti-CWB Milling, Boring, and Combined Machines

The Mitsubishi Shipbuilding & Engineering Co., Ltd. (Mitsubishi Zosen Kabushiki Kaisha), with its head offices at Marunouchi, Tokyo, Japan, and one of many sales agents, Mitsubishi International Corporation located in New York City, introduced a milling, boring, and combined machine at the Coliseum Machinery Show held recently in Chicago. This production equipment (shown in the illustration), known as the Mitsubishi-Innocenti-CWB milling, boring, and combined machine, will be produced in floor type, planer type, and other combination types, the diameter of spindles being 140 mm for milling and 95 mm for boring.

This multiple-process combination machine was designed and patented by Mr. C. W. Berthiez, and its regular manufacture and marketing was started around 1950 by Innocenti S. G. of Italy. A technical assistance agreement between Innocenti S. G. in Italy, the licensed manufacturer, and Mitsubishi has been concluded, under which Mitsubishi Shipbuilding & Engineering Co., Ltd., obtained the world's exclusive manufacture and sales rights on the machine illustrated. The manufacture of this machine was started by Mitsubishi in November, 1959.



Milling, boring, and combined machine introduced by the Mitsubishi Shipbuilding & Engineering Co., Ltd.

The machine embodies special characteristics and unique functions which enable all the necessary processing of the work-piece to be done at a single setting with the aid of various attachments. The attachments, of course, depend on the respective work-pieces. In the case of continuous mass production, very high efficiency is obtainable by the use of the automatic work-piece locating attachment. It is also claimed that a greater degree of accuracy in the finished work-pieces, especially in regard to parallel and right angle surfaces, substantially shortens production time.

Headstock and main spindle are designed to obtain a large torque at low speed. For this purpose the sleeve system is employed, the headstock being provided with a large front face with slots for mounting the various attachments. With these attachments the headstock travels 400 mm

longitudinally. The working point of the tool or cutter is thus supported close to the work-piece, and enables heavy cutting to be done. It also eliminates deflection and torsional vibration of the machine elements.

The machine is designed for heavy high-speed cutting as well as fine surface finishing. A high-speed spindle (3400 rpm) and a main spindle (1000 rpm) are provided. The former is direct motor-driven and the latter is driven by a two-step gear train that utilizes the full power of the motor. Thus the faceplate, provided with an internal gear, makes any stepless cutting speed possible within the range of from 3400 to 217 rpm. Movable parts, such as the column and the headstock, float on an oil film of 1/100 mm, so that sensitive feeding and manual positioning is facilitated. For the purpose of lightening the loads imposed by moving members, a hydraulic balancing system is used. All these special characteristics are suitable for the automation system, such as magnetic rule or tape control.

Circle 566 on Readers' Service Card

Ex-Cell-O Introduces Newly Acquired Contour Projectors

The Ex-Cell-O Corporation, Detroit, Mich., presented its entire line of newly acquired contour projectors at the recent Machine Tool Exposition in Chicago. This line includes six models ranging in screen size from 8 to 30 inches. Featured in the Exhibit was the Model 14-5 with 14-inch screen whose basic design has made it a standard precision optical measuring instrument for many years. Versatile, rugged, and accurate to tenths, its "heart" is the famous optical system designed and manufactured by the Eastman Kodak Co. Coated Ektar lenses in the optics and the Fresnel lens behind the screen give bright, glare-free images under normal room illumination.

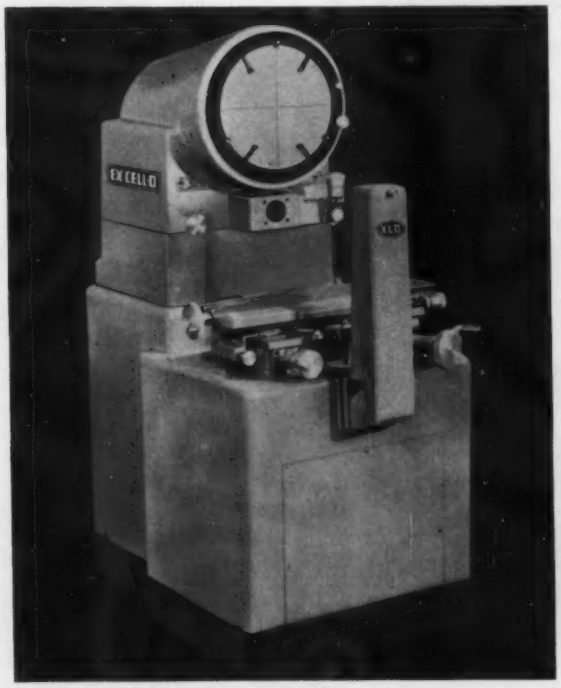
Most important is the fact that these Ex-Cell-O contour projectors afford the operator the largest staging area with plenty of room to measure large objects. Featured also in this Exhibit is the Model 30 with drop front, developing a staging area that will accept and measure parts up to 12 inches in diameter.

Circle 567 on Readers' Service Card

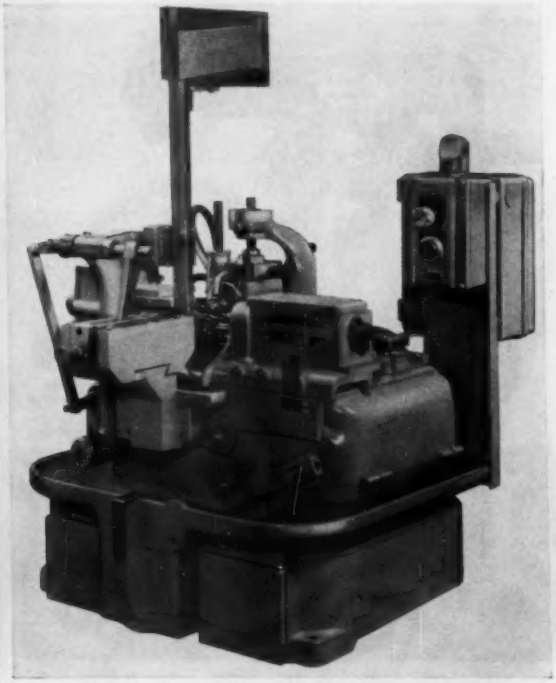
Gear-Hobbing Machine for Mass Production of Miniature Gears

A gear-hobbing machine, with shuttle type loading and complete automation, which has speeds up to 4084 rpm for fast, high-volume production of small, fine-pitch instrument gears was introduced at the recent Machine Tool Exposition in Chicago by the Barber-Colman Co., Rockford, Ill. This No. 1 1/2 machine was shown in operation. It can perform all handling and hobbing operations on small spur gears, pinions, and special tooth forms at rates higher than 1000 per hour.

The new hobbing machine is equipped with anti-friction workslide and hob spindle. All shafts run in needle bearings. Accurate tooth forms can be produced in seconds, hobbing brass, aluminum, phenolic, and other materials in the same machinability range. The automatic cycle can



Ex Cel-O contour projector equipped with 14-inch screen



Fully automated Barber-Colman gear-hobbing machine

include feeding, holding, clamping, driving, hobbing, deburring, and ejecting. The machine can cut gears as fine as 268 pitch with consistent, high accuracy. Precision adjustments are provided for shifting and setting the hob. Maximum work capacity is 1 inch in diameter by 1/2-inch face, from 24 DP in brass and 36 DP in steel.

Circle 568 on Readers' Service Card

Sajo Duo-Mill with Toolmaker's Overarm

A Model 52 Duo-Mill, a new addition to the SAJO (Swedish) line of knee type horizontal and vertical milling machines, is being introduced in this country by the Austin Industrial Corporation, White Plains, N. Y.

The Duo-Mill is a dual-purpose miller which combines in one machine the facilities of both a horizontal and vertical milling machine. It features a special overarm on which is mounted a universal vertical milling head powered by the 3 1/2-hp main-drive motor. The compound swivel arrangement of the all-angle vertical head provides unusual versatility, allowing milling operations at any point within a 360-degree vertical circle.

Change-over from vertical to horizontal milling is made in a matter of seconds. The universal head can quickly be swiveled out of the way and the machine operated as a conventional horizontal miller, using the outboard arbor support mounted on the overarm.

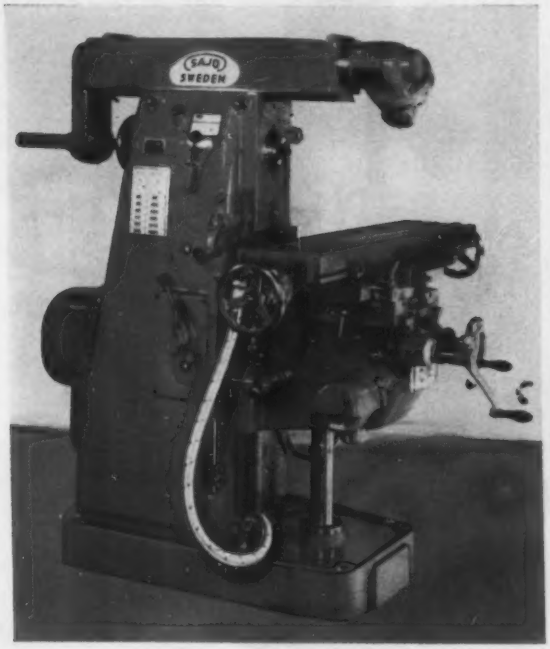
The Duo-Mill has a 3/4-hp table feed motor. Manual and power feeds in three directions are available. The longitudinal feed is 27 1/2 inches; the cross-feed, 8 1/4 inches; and the vertical travel, 18 1/4 inches. The table has a working surface of 41 3/8 by 9 1/4 inches. The machine is also available equipped for horizontal milling only, with conventional overarm and overarm braces in place of the toolmaker's overarm.

Circle 569 on Readers' Service Card

Numerically Controlled Drilling Machine

Drilling, tapping, reaming, boring, and straight-line milling operations are fully controlled and programmed by the new line of numerically controlled drilling machines brought out by the Hillyer Corporation, Cranford, N. J. These machine tools permit spindle speed, feed rate, and depth settings to be fully controlled by both tape and dial along with conventional x and y coordinates. Any combination of these three controls may be selected for any spindle at any time, permitting a given tool to be programmed to varying levels and varying depth of holes, all on the same work-piece. No jigs or fixtures are required for work handled on these machines. Accuracy and speed of actual machining operations are said to be high. Holes can be located and drilled to accuracies of 0.001 inch per foot. Production of up to fifteen holes per minute is obtained on continuous fully automatic operation of this machine.

The dial-control panel and tape reader are mounted integrally with the machine. The tape reader uses either a 4-inch direct-reading decimally coded plastic tape or Flexowriter 1-inch paper tape. Tape preparation is simple and speedy and does not require expensive equipment. Using a hand punch, the direct-reading tape can be punched at the rate of 100 hole positions per hour. Since the tape is punched directly



Duo-Mill with toolmaker's overarm introduced by the Austin Industrial Corporation

Hillyer numerically controlled drilling, tapping, reaming, boring, and milling machine

in decimal form it is not necessary to have specially trained personnel for this operation. A simple keyboard-operated punch is used with Flexowriter tape which is either looped or automatically rewound at the end of each program cycle.

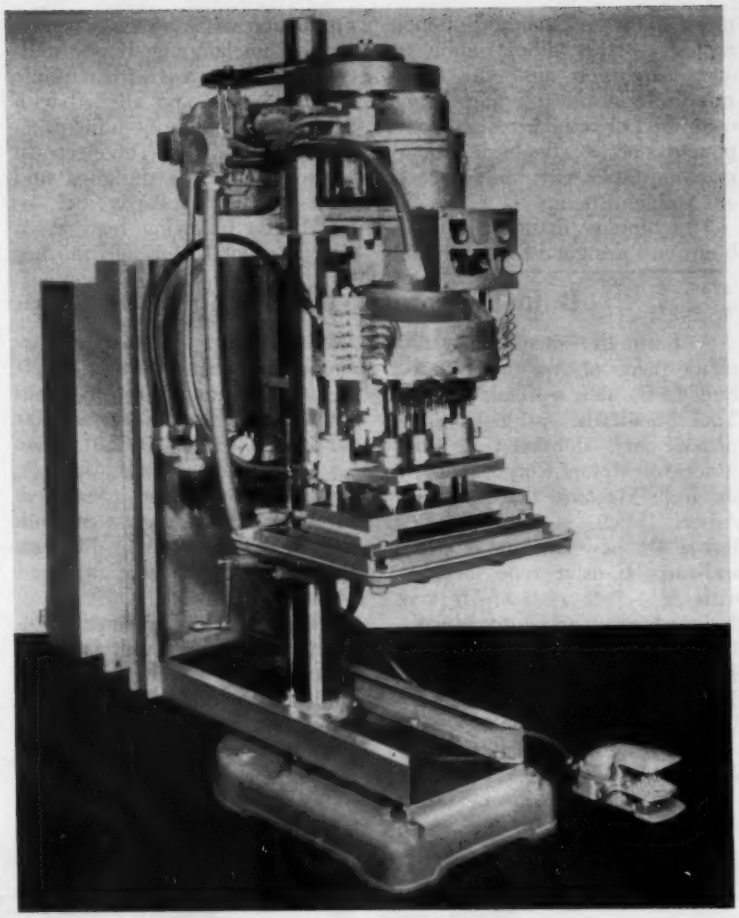
Circle 570 on Readers' Service Card

Tapping Head for Terminal Strips

A multiple-spindle tapping head designed for simultaneous tapping in short cycle time without a reversing motor has been developed by Zagar, Inc., Cleveland, Ohio. Threading holes with 8-32 taps in a two-second cycle at the rate of fifty holes per pass is possible through gearless design and new drive concepts. A triple electric clutch and brake in the gear-box permits the motor to drive forward continuously through the flywheel and reverse gear shaft. The necessity and expense of a specially wound reversing motor are eliminated.

A lead-screw controls the in-and-out feed of the terminal strip. The compact head can be easily installed on standard drill presses. Thus, special tooling and additional machinery are not required.

Circle 571 on Readers' Service Card

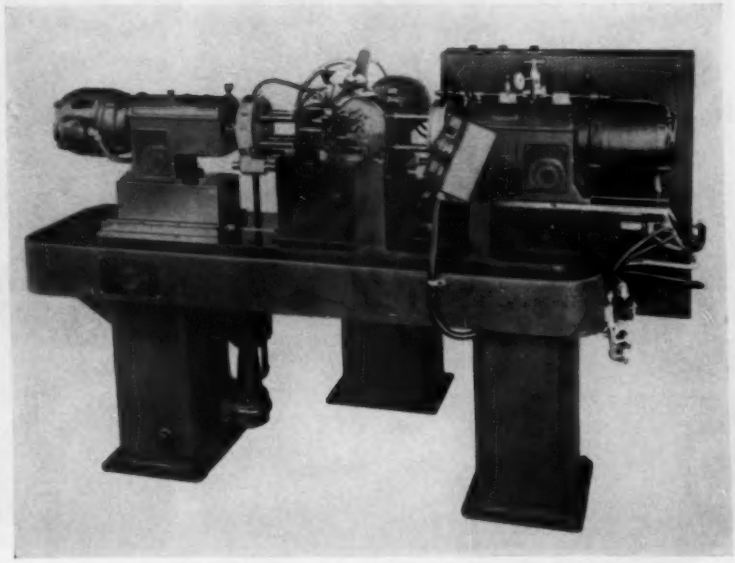


Zagar tapping head for terminal strips applied to drill press

Special Three-Way Machine for Multiple Tapping of Compressor Blocks

A special three-way, horizontal lead-screw tapping machine for high-speed production of cast-iron compressor blocks has been designed and built by the Ettco Tool & Machine Co., Inc., Brooklyn, N. Y., for a leading automobile manufacturer. This machine utilizes the builder's standard interchangeable components assembled around a custom-designed fixture.

The machine taps four 1/4-20 holes, four No. 8-32 holes, and two 1/4-20 holes in three different planes to complete a total of 325 compressor blocks an hour. The standard components used in the machine include three of the company's ATU No. 3 lead-screw tap-



Ettco special three-way machine designed for multiple tapping operations

ping units, a standard 6-inch rapid-traverse sliding subbase, and three custom-built fixed-spindle multiple tapping heads composed of standard Ettco components on a standard ground machine table with built-in coolant tank and pump.

The tapping fixture is custom built, and designed for maximum production with automatic clamping and unclamping. It was unit-engineered for use with multiple tapping heads, and aligned with fixture and lead-screw units using built-in guide rods. The electrical control panel was designed and built to JIC standards and includes the following features: a selector switch for all moving components to facilitate setup; an emergency return switch as a safety feature, and convenient start and stop push buttons. Tap protection is provided by individual lead-screw unit electromagnetic clutch control, while correct operational sequencing is assured by safety electrical interlocks.

Circle 572 on Readers' Service Card

Buhr Economatic Built to Special Machine Tool Standards

A Buhr Economatic, the first major piece of equipment to be built to the new Special Machine Tool Standards, has been completed and delivered to the American Motors Corporation by the Buhr Machine Tool Co., Ann Arbor, Mich. Called "Buhr's Baby," the new machine is a lift-and-carry transfer type machine with fifty-eight stations. It was designed to perform automatically 323 precision operations on cylinder heads for 1961 automobiles at the plant of American Motors Corporation, Kenosha, Wis.

Operations, in addition to rough and finish machining, include probing, sealer applications, assembling, pressure testing, rejecting, and injecting. The work cycle is thirty seconds. Capacity at 100 per cent efficiency is 120 pieces per hour. In its progress through the machine, the part is rotated through 90 degrees twice and tipped 90 degrees four different times to present appropriate faces to the tooling.

The Special Machine Tool Standards are the result of joint effort between leading users and builders of multiple-operation machine tools, governing the design of such factors as the mounting and attaching surfaces of main bases, wing bases, feed units, horizontal angular adapters, angular columns, and the bolting patterns of these units. They also govern the uniform work-loading height and the application of specific components utilized in the construction of multiple-operation machine tools.

By increasing the convertibility and flexibility of this equipment and standardizing the various units, new areas of application for machines of this type have been opened up. Their economy in areas where they have long been used has also been increased. These developments also make it

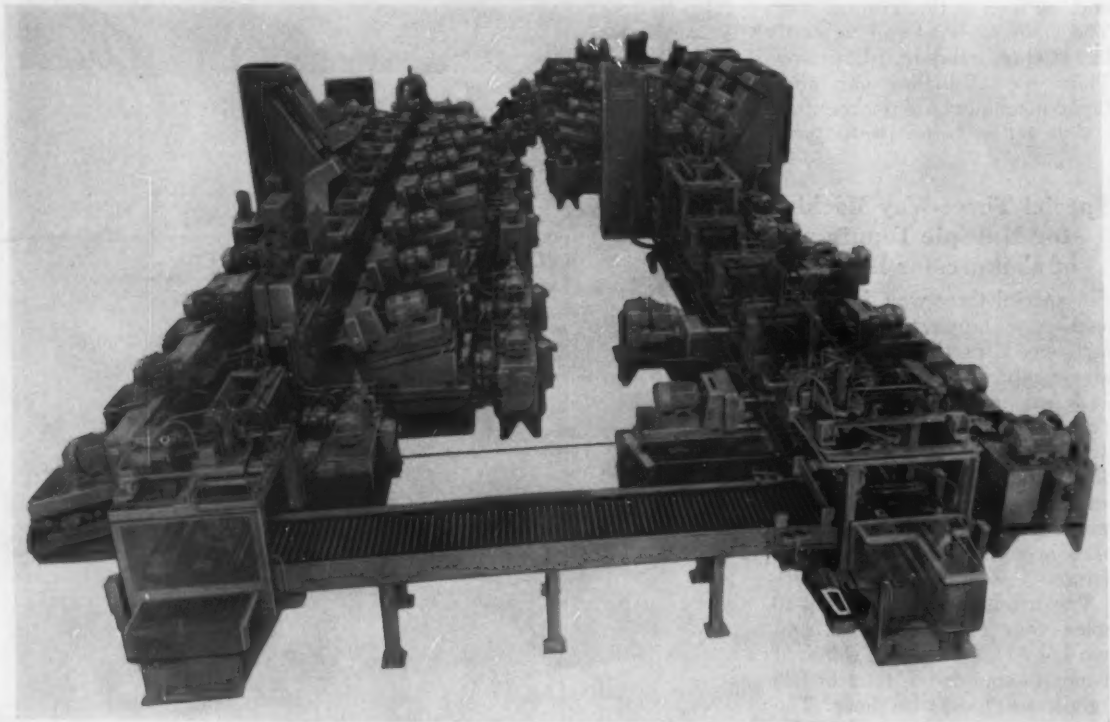


Fig. 1. Economatic lift-and-carry type transfer machine built to Special Machine Tool Standards by Buhr Machine Tool Co., for American Motors

possible for the medium- and small-volume producer to utilize such equipment on an economical basis.

In addition to being the first major piece of equipment built to the new standards, this machine, Fig. 1, is also of especial interest because it introduces basic engineering and design changes in areas not covered by the standards. Among these innovations is the new hydraulically operated way type feed unit which is actually a compact power package with all controls panel-mounted directly on its side. Only three hydraulic lines need be disconnected to move or remove the units. These units also provide a 60 per cent increase in rate of rapid traverse and a 50 per cent increase in structural strength. Incorporation of a differential circuit reduces oil consumption 50 per cent, permitting the use of smaller-volume pumps.

In addition to greater flexibility and more efficient, trouble-free operation, design of the way type feed units provides ready access to tooling. Fig. 2 shows the loading end of the machine with cylinder head in position, on lift-and-carry transfer, just before moving into the first station. Here the part is tipped 90 degrees on its side for movement through the guide bars. The transfer bar actually picks up the part from the preceding machine, which rough-mills the joint face, top face, and exhaust manifold face of the cylinder head. The tipping mechanism at the first station is hydraulically operated and located by means of a thermostat hole and Welsh plug hole in the ends of the cylinder head.

The extremely clean lines, ready access to tooling or work-piece in any station, and more than ample room between stations for ease of maintenance are exemplified by the unit shown in Fig. 3. This illustration shows the eccentric units which mill the contoured combustion chambers. The head of this unit advances and mills to depth; then the entire way unit moves on the eccentric cradle to mill the required contour. Oval openings in the bushing plates permit four-way movement of the tools.

An interesting feature of the operator's control console is the arrangement of neon indicating lamps in the same relative positions as the locations of the operations which they indicate on the machine. A failure of any component of the machine or a loss of lubrication prevents the machine from recycling, and the location of failure is automatically indicated on the operator's control console.

The length of the lift-and-carry transfer line of this machine is 220 feet. The machine is approximately 100 feet long, 40 feet wide, and weighs 225 tons. Sixty-five motors with a total output of 520 hp provide ample driving power. There are sixty-nine timers, fifty-eight starters, and 230 limit and press switches.

Circle 573 on Readers' Service Card

Giant Surface Grinder with Quick-Tilt Spindle

Extra-large work-pieces can be rough- and finish-ground in a single operation on a Quick-Tilt vertical rotary surface grinder with a 60- to 72-inch magnetic chuck manufactured by Mattison Machine Works, Rockford, Ill. The massive construction of this machine permits application of 125

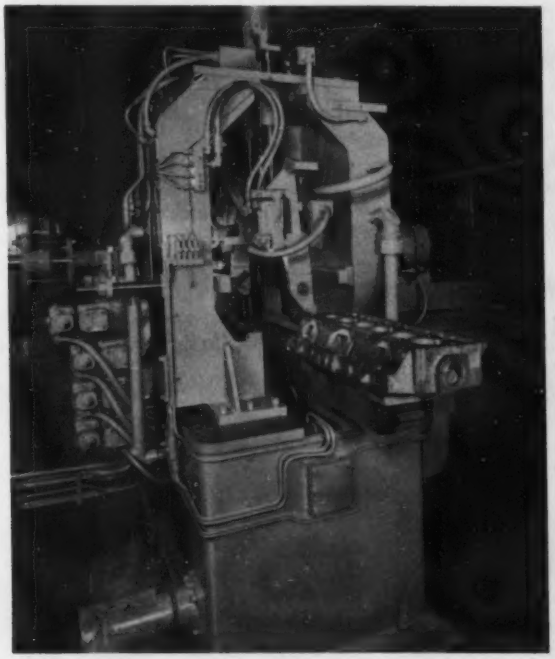


Fig. 2. Loading end of machine shown in Fig. 1, with cylinder head to be processed on lift-and-carry transfer

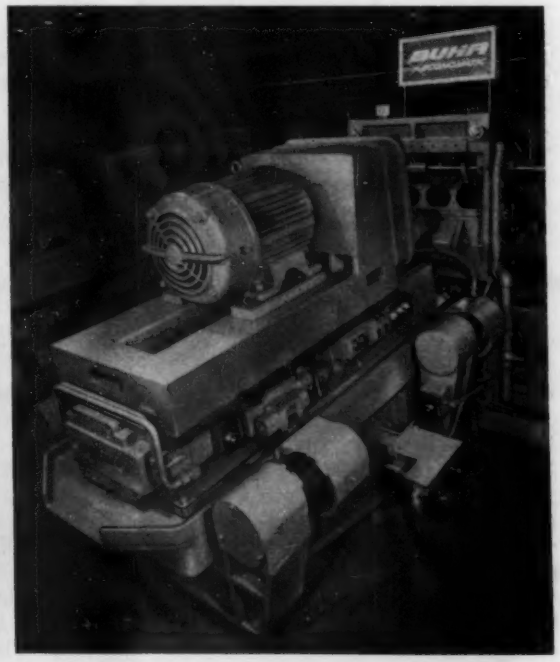
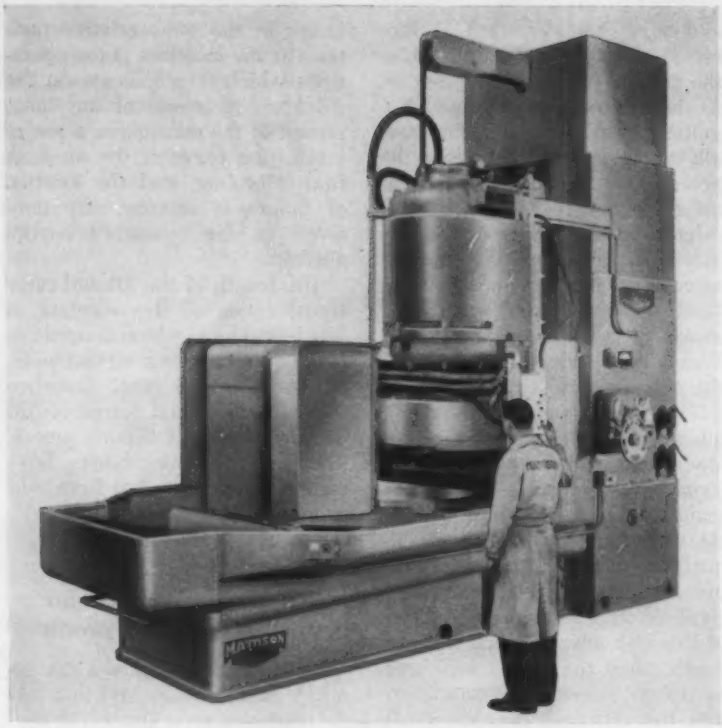


Fig. 3. Typical unit of machine illustrated in Fig. 1, equipped for contour-milling combustion chambers



One setup on this Mattison rotary surface grinder with Quick-Tilt spindle handles rough and finish grinds on extra-large work-pieces

hp through the spindle. A unique feature of the equipment is Mattison's new selector-switch-actuated power spindle-tilting arrangement. For the first time, work can be machined with a hogging cut to within a few thousandths of final size, grinding with the leading edge of the wheel to increase grain penetration, then finish-grinding in the same setup. The massive one-piece column and rigid wheel-head permit utilization of maximum power without deflection or vibration.

The slight concavity produced in the work by the elliptical generating plane of a tilted wheel is quickly removed in finish-grinding. The operator merely turns a selector switch and an air cylinder actuates the spindle-tilting mechanism. This returns the wheel to the dead-flat position, so there is practically no down time between rough and finish cycles. Precision tolerances and cross-grind finish are economically feasible on every job.

Antifriction table bearings are a new feature of the 60-inch rotary table. A total of 850 precision ball bearings are spaced in four rows between the carriage and table ways. These bearings reduce power requirements, an important factor when machining extra-heavy work. Down feed is continuous from 0.005 to 0.165 ipm. It is disengaged instantly when the desired size is reached by a preset stop. With continuous down feed, it is possible to split the last increment of a ratchet type feed to meet close-tolerance limits. The operator can set the machine for maximum feed and grind to size in one cut without taking micrometer measurements.

Controls are centralized on an adjustable pendant which rides a bar on the column. A handle at the bottom of the pendant uses the pendant's weight to clamp the bar in any position convenient to the operator. Pictograph symbols and directional switches assure quick identification of controls for each machine function.

The Model 60 grinder features block type styling and is available with 60- to 72-inch magnetic chucks. The 72-inch chuck can be furnished with a dead ring to 84 inches. Grinding wheels of 32, 36, and 42 inches are available.

Circle 574 on Readers' Service Card

Medium Size-Range Vertical Spindle Boring Mill Offers Tape Control

A numerically controlled "Precision" Versa-Tronic boring, milling, drilling, and tapping machine has been brought out by the Lucas Machine Division, New Britain Machine Co., Cleveland, Ohio. This machine is designed to work with accuracy approaching that of a jig borer, but is larger, handles heavier work, and takes heavier cuts. It introduces a new order of versatility in a single machine under a single digital punched-tape program, via the General Electric Mark III control system. This equipment is especially designed for medium- and short-run production work where maximum flexibility is needed because of frequent changing from one lot to another.

The boring mill (Fig. 1) is suited for complete, automatic machining of large side-frame sections, such as those in earth-moving equipment, printing presses, packaging, weaving, and food machinery, as well as machine tools. The equipment permits savings in work-piece handling, jigs and fixtures, setup time, special tooling, operator error, scrap losses, and over-all production time.

The basic design consists of a long cast bedway (23 feet 4 inches) having two flame-hardened, precision-ground rectangular way surfaces. One way is finished accurately on its vertical surfaces to guide the 66- by 146-inch cast table as it moves through its 132 inches of travel. The table has finished T-slots for aligning and clamping the work-piece. Cross-aligning slots are also provided to

facilitate setting up work. Two columns are attached to the bedway at its approximate center. Flanges cast around the column base section and the bedway section provide for leveling screws and a hold-down arrangement.

The left-hand column base contains the 20-hp driving motor, the speed and feed change-gear boxes, and the unit feed engaging box. The columns guide and support a cross-rail which moves 72 inches vertically, parallel to the table beneath. This cross-rail carries a head containing a sleeve with 4-inch vertical spindle which travels crosswise between the two columns. Large face-milling cutters up to 14 inches in diameter can be used for heavy work. Smaller milling cutters, boring tools, or drills can be carried in the taper of the sliding spindle which has a 24-inch travel within the sleeve. The sleeve is mounted in precision tapered roller bearings to insure accuracy for close-tolerance boring operations.

Precision screws, each having a micrometer dial for quick, accurate hand setting, control the following movements: longitudinal table travel; vertical cross-rail travel; crosswise spindle head travel; and vertical spindle travel in and out of the sleeve. In addition, the vertical adjustment of the cross-rail is arranged to read out on dial indicators for the use of precision end-measuring rods to locate the unit to jig-boring tolerances through automatic positioning control.

Accurate alignment of the machine permits fine-tolerance milling. Vertical travel of the cross-rail on the columns is accurate within 0.0005 inch. Crosswise travel of the spindle head on the cross-rail is accurate within 0.001 inch over its 78-inch travel. Sweep from spindle to ways is held within 0.0002 inch per foot.

Working range of the machine is 132 inches long, 78 inches wide, and 72 inches high. Features of the machine include automatic tool changing; operation under manual, keyboard, or punched-tape control; and an extensive tool selection.

The General Electric Mark III control system permits the Versa-Tronic to be operated in any of three modes, set by a selector switch on the operator's console, Fig. 2. It may be operated manually by setting dials and selector switches on the machine's pendant control. Through decade push buttons on the operator's console, motions may be positioned electrically to 0.0001 inch. Feeds and speeds in this semiautomatic mode

Fig. 1. Controls on the Lucas Versa-Tronic can order automatic tool changing, any of forty-two feed rates and ten automatic sequences

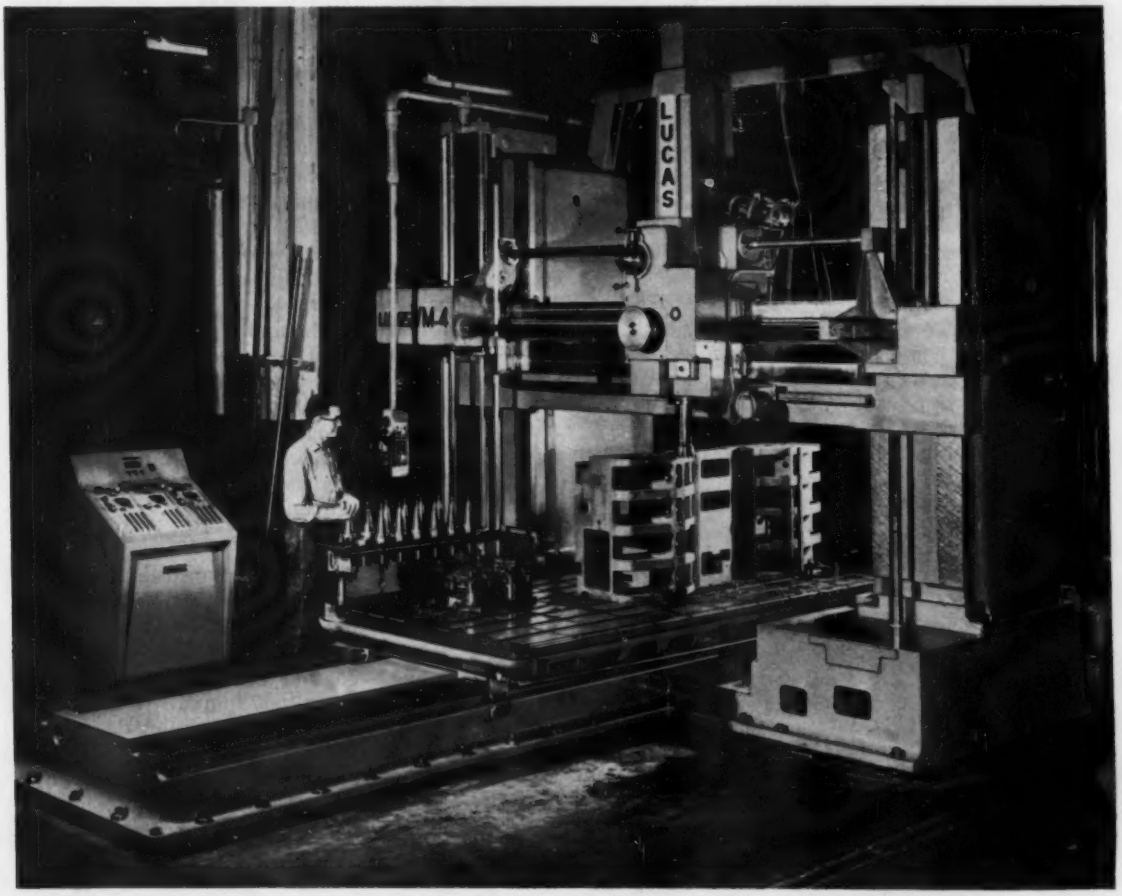
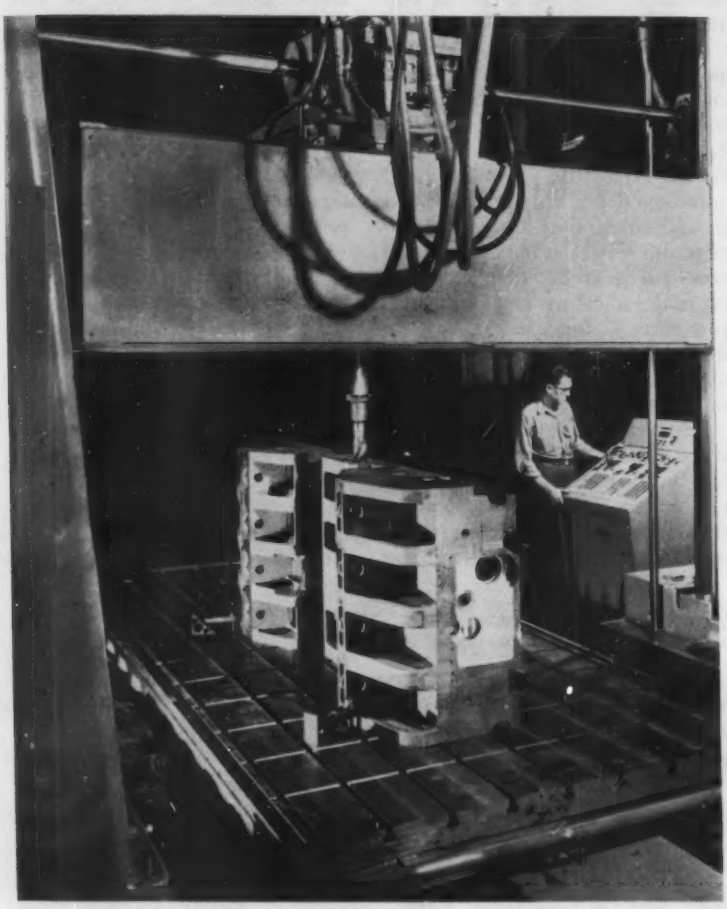


Fig. 2. Numerically positioned Lucas vertical boring mill drills a big hole in a machine tool bedway nearly as large as a compact car



are selected manually from the operator's pendant. The third mode permits completely automatic operation using standard 1-inch punched-tape control. The Versa-Tronic will use a programming code identical to the one used by Lucas on its horizontal drilling, boring, and milling machines. The positioning control automatically adjusts motion of the work-table, the spindle head on the cross-rail, and the spindle up and down movements.

All motions may be positioned simultaneously, or individually, as desired. A special backlash take-up circuit increases accuracy by causing the final positioning of each motion to be made from the same direction each time. All motions are positioned from a zero reference point on the machine, which can be moved electrically plus or minus 0.200 inch to simplify setting up a work-piece on the table.

In addition, the control provides for tape selection of several auxiliary functions, including: forty-two different feed rates and any of twenty-five spindle speeds; and rapid traverse, of 75 ipm on all motions. In standard positioning, this is engaged until the machine is within 0.200 to 0.300 inch of desired location when final positioning is done at a creep feed speed of 1.1 ipm. Ten common operating sequences can be programmed for continuous operation without stopping for further tape reading. These include tapping, with spindle reversal and retraction; fine drill boring; coarse drill boring; drill boring and dwell at final depth; traversing to feed position without stopping; standard positioning; coarse positioning, eliminating creep feed; orienting spindle for tool pickup; milling; and selective feeding rate.

Automatic tool changing is greatly simplified by the design of the Versa-Tronic. To select a tool, its storage location is simply programmed into the tape and the spindle positions to locate over it. Downward motion of the spindle, also tape-controlled, fits the tool in place.

The tool is secured by a "Power Tool Lock and Ejector" built into the spindle. A draw collet in the spindle is cycled open by the automatic control to receive an adapter on the tool, then closed to wedge-lock it in place for subsequent operations.

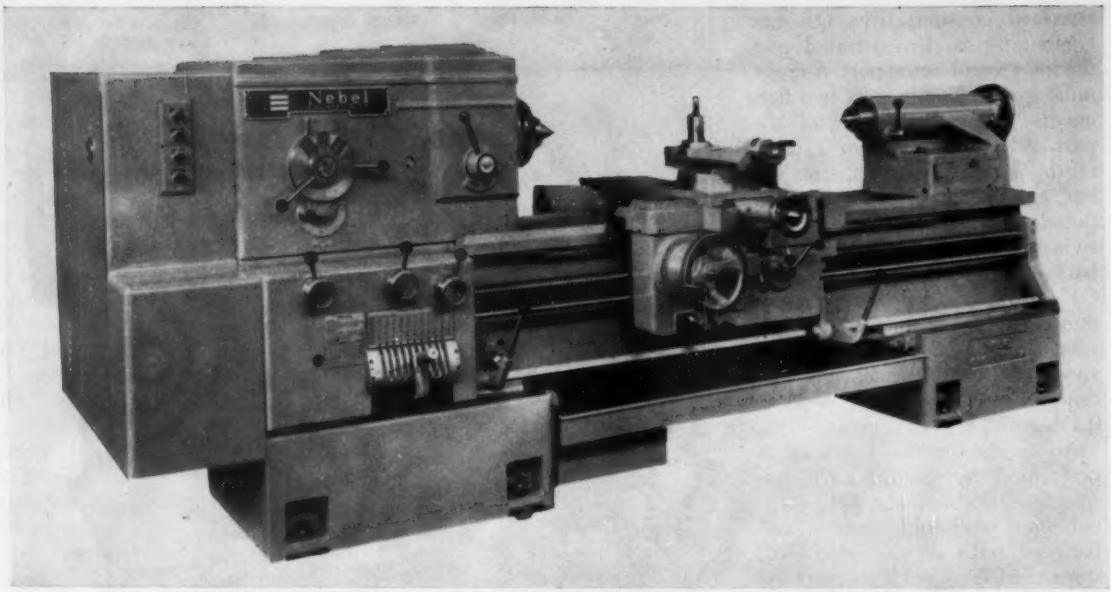
Circle 575 on Readers' Service Card

Nebel Engine Lathe with Unique Gear-Box

A totally enclosed gear-box of unusual design is a feature of the Model SD 2516-20 standard-duty engine lathe announced by the Nebel Machine Tool Corporation, Cincinnati, Ohio. This fourth model of an entirely new line of lathes is designed to offer unusual operating convenience, as well as assure precision work. It has more and higher spindle speeds than previously available on Nebel lathes.

The heavy-duty, quick-change gear-box combines the advantages of total enclosure with a simple, reliable tumbler gear arrangement. An oil seal and telescopic shifter-shaft arrangement reduces the number of parts to a minimum and achieves the shifting ease of positive tumbler gears. The eighteen gear-driven speeds are simply selected from a direct-reading color index and easily controlled by two levers and color-keyed speed plates. Speeds up to 1500 rpm are available. The heavy-duty headstock design provides for wide-faced, shaved and hardened gears, with short, heavy, multiple-splined shafts mounted on antifriction bearings.

Sixty separate feeds from 0.0027 to 0.192 ipr, and sixty separate



Engine lathe with totally enclosed gear-box announced by the Nebel Machine Tool Corporation

thread changes from 1 to 72 threads per inch are selected simply by moving the shifting handle to the desired feed or lead shown on the direct-reading tumbler index-plate. The tumbler gear is locked in position by a positive catch. In the low spindle-speed ranges, feeds and leads can be changed without stopping the spindle. A constant-speed main drive motor supplies up to 20 hp through a multiple-disc clutch and brake mounted externally on the headstock for easy maintenance and adjustment.

The heavy-duty tailstock, with its large-diameter spindle, moves under power from the longitudinal feed mechanism, if desired, by engaging the carriage through an interlock. A heavy-duty thrust lock, engaging a rack located in the bed, prevents the tailstock from moving on the bedway under heavy loads.

Circle 576 on Readers' Service Card

Conomatic Permanent Exhibit of Automatic Lathes

On September 1, the Cone Automatic Machine Co., Inc., opened a permanent exhibit at its Windsor, Vt., plant where users and prospective users of its Conomatic automatic lathes can see these machines in action. Eight models—six multiple-spindle automatics and two single-spindle, copy-turning multiple-cycling automatics—will be in operation demonstrating outstanding production features of the entire Conomatic line. Two of these models, the 9/16-inch six-spindle QF bar Conomatic and the 10- by 35-inch KU Conomatic pilot lathe described and illustrated on page 177 of the September National Machine Tool Exposition number of MACHINERY, are included in the permanent exhibit.

The 9/16-inch, six-spindle QF (stop spindle) bar machine, the stop-spindle counterpart of the

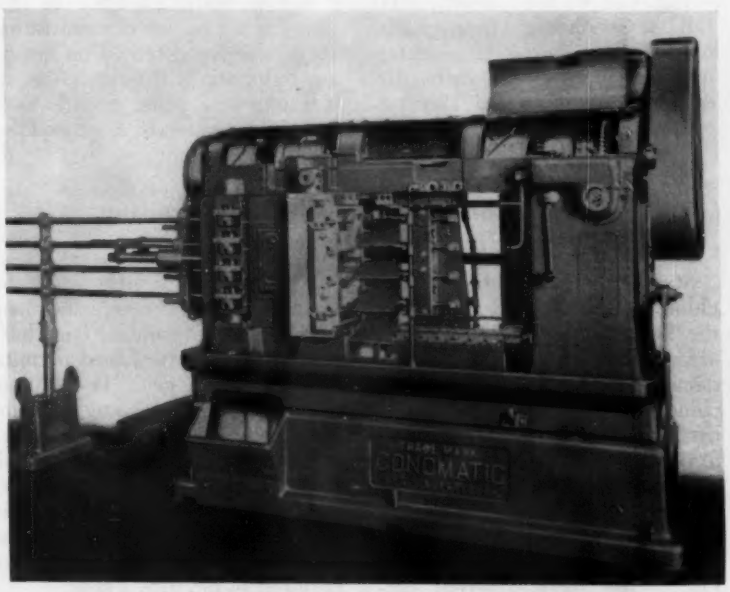


Fig. 1. Cone Automatic Machine Co.'s 1 1/2-inch 4-Hi Bar Conomatic DB

standard constant-drive QE bar Conomatic, is demonstrated producing a small union part. A cross-milling attachment mills two flats on the outside diameter of the part. A pickoff attachment picks off the part as it is cut off from the bar, and presents it to a left-hand fluted drill, held by an arm that swings the drill into position for back-chamfering the hole. The QF has a recommended maximum work spindle speed of 3500 rpm. The recommended maximum speed of the QE is 5259 rpm. Idle time for each machine is held to 0.458 second.

Another interesting operation is performed by a 9/16-inch, six-spindle QE collet chucker, without stock reel and conventional bar feed, but with magazine feed, stops, and ejectors. This machine completes the second operation on a valve stem part produced from a brass casting.

There is a 1-inch, six-spindle TS bar Conomatic which produces a chain roller, a spark plug shell, and a threaded adaptor. Machining these parts effectively demonstrates the various time and cost savings possible from the job change-over features of Conomatics. A 1 5/8-inch, six-spindle TF bar model is also shown producing a pivot pin. The tooling features an effective deep-hole drilling attachment.

Fig. 1 shows a 1 1/2-inch, 4 HI DB bar Conomatic, a four-spindle, nonindexing forming, chamfering, and cutting off automatic, equipped with special rheostat-controlled variable work-spindle drive, which produces spacer parts, four at a time. The surface speed of the work and the feed per surface foot are maintained as the form tools and cutoff tools approach the axis of the work.

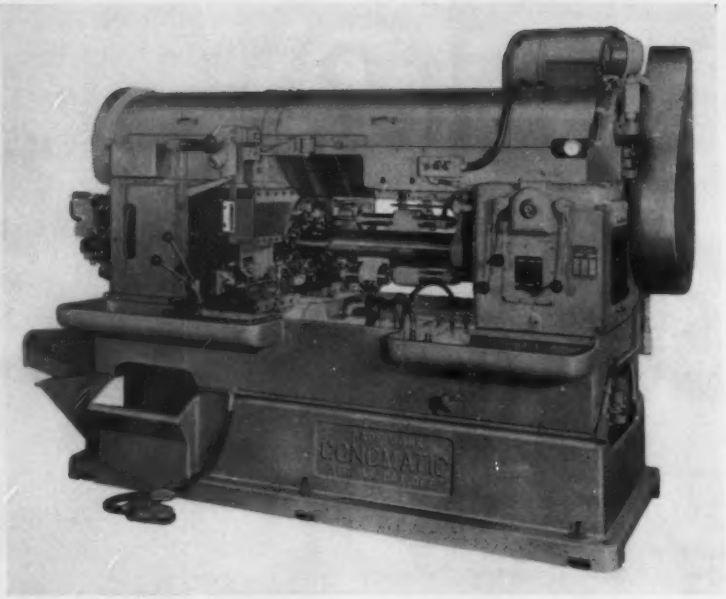


Fig. 2. Six-spindle, 5 7/8-inch TE Conomatic chucker

A 5 7/8-inch, six-spindle TE chucking Conomatic (Fig. 2), equipped with air chucks and magazine feed, machines a thrust bearing-race stamping with carbide tools. Final operation picks parts off arbor to back-chamfer it.

A Conomatic Pilot KU-10 machine is set up for demonstrating its productive potential on heavy, rugged work in the machining of a tractor axle, using carbide tools at substantial feeds. Another Pilot Model KU-7 produces a part that capably demonstrates the flexible application of the machine to the copy turning of the left or right side, or both sides, of straight shoulders. The part is a multiple-shouldered feed roll bar for calculating machines. The versatile KU Conomatic Pilot lathes also make provision for the application of two independent slides, operating in either direction, for front and rear tooling. These Pilot machines are built and marketed in the United States by the Cone Automatic Machine Co., under rights granted by H. Ernault-Batignolles of France.

Circle 577 on Readers' Service Card

Barber-Colman Automated and Precision Gear-Hobbing Machines

Standard type hobbing machines on which all functions of the hob carriage and work-slide are controlled automatically were demonstrated at the recent Machine Tool Exposition in Chicago by the Barber-Colman Co., Rockford, Ill. These machines are said to introduce new economies for both high-volume and job-lot production of gears and splines. The No. 16-16 Multicycle machine, Fig. 1, has three different preselected work cycles. Besides being automatic, the new machines are said to be more versatile than previous conventional models. Their power vertical feed permits hobbing worm gears in addition to hobbing the usual range of spur and helical gears and splines. Power feed in both the horizontal and vertical axes can often substantially reduce the approach which frequently accounts for a high percentage of the total time required to produce a gear.

The big difference in Multicycle hobbing is in the way the work and hob are positioned quickly and in the most direct manner by any of three coordinated cycles. The first method, known as the "square" cycle, is an automatic version of the conventional cycle, with rapid vertical positioning of the work-slide and rapid horizontal return of the hob carriage. The second method, called the "plunge" cycle, is automatic and has variable down feed, plus rapid positioning of the work-slide. Finally, the third method, the "plunge-approach" cycle, is a combination of the

other two, providing the shortest possible approach to full depth at the beginning of the cycle.

Cams control actuation of the work-slide and variable vertical feed. Convenience of cam adjustment, plus easy preselection of the machine cycle and quick setup, makes automatic cycling fully practical for any number of pieces to be produced. Appreciable savings other than those which result from a reduction in nonproductive time may be derived from Multicycle versatility. For example, with the plunge-approach cycle, it is often economical to use larger hobs having more flutes and/or threads than would be used in hobs designed for a conventional setup. Faster indexing with multiple-thread hobs increases production. Increase in the number of flutes often increases both accuracy and production. Multicycle versions of both the standard 16- and 6-inch Barber-Colman hobbing machines are now available, without change in work or hob size specifications or machine capacity.

The Model No. 2 1/2-4 hobbing machine, Fig. 2, was also exhibited at the show. This machine offers a potential cost advantage to producers of AGMA Precision Class 3 gears. It will hob highly accurate, fine-pitch spur gears such as required in instruments for guidance and control systems of missiles, high-speed aircraft, radar, and other navigation and sensing equipment. An unillustrated but more complete description of this machine was given on page 201 of the September Machine Tool Exposition number of MACHINERY.

Circle 578 on Readers' Service Card

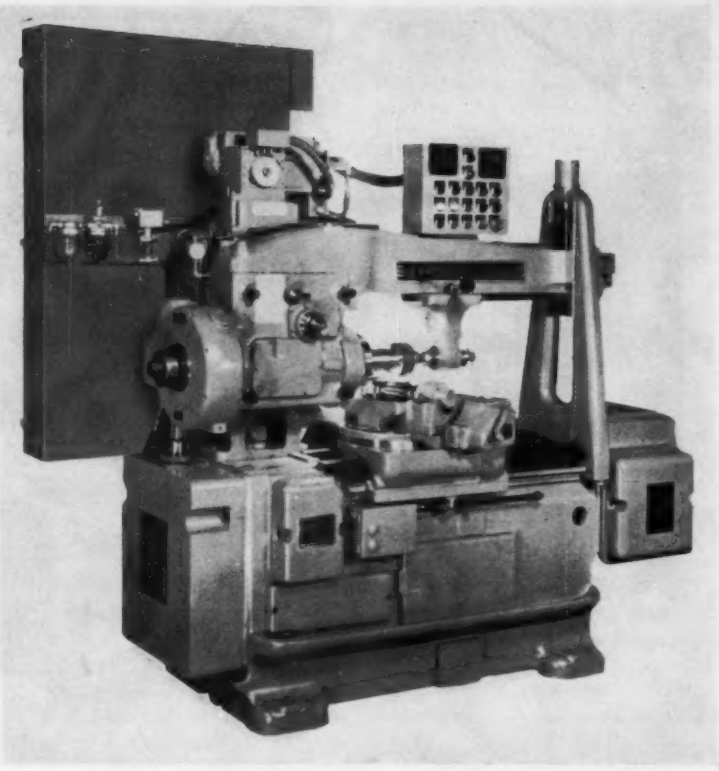


Fig. 1. Barber-Colman No. 16-16 Multicycle hobbing machine

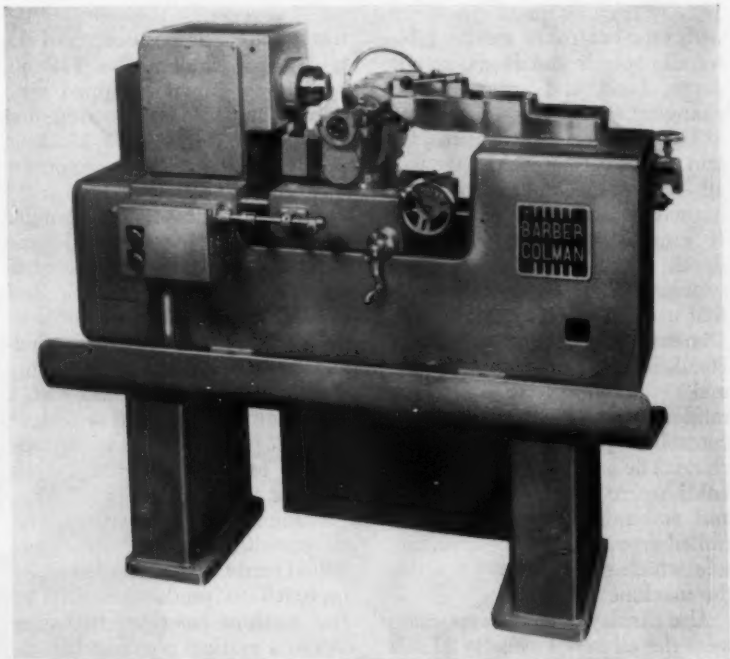
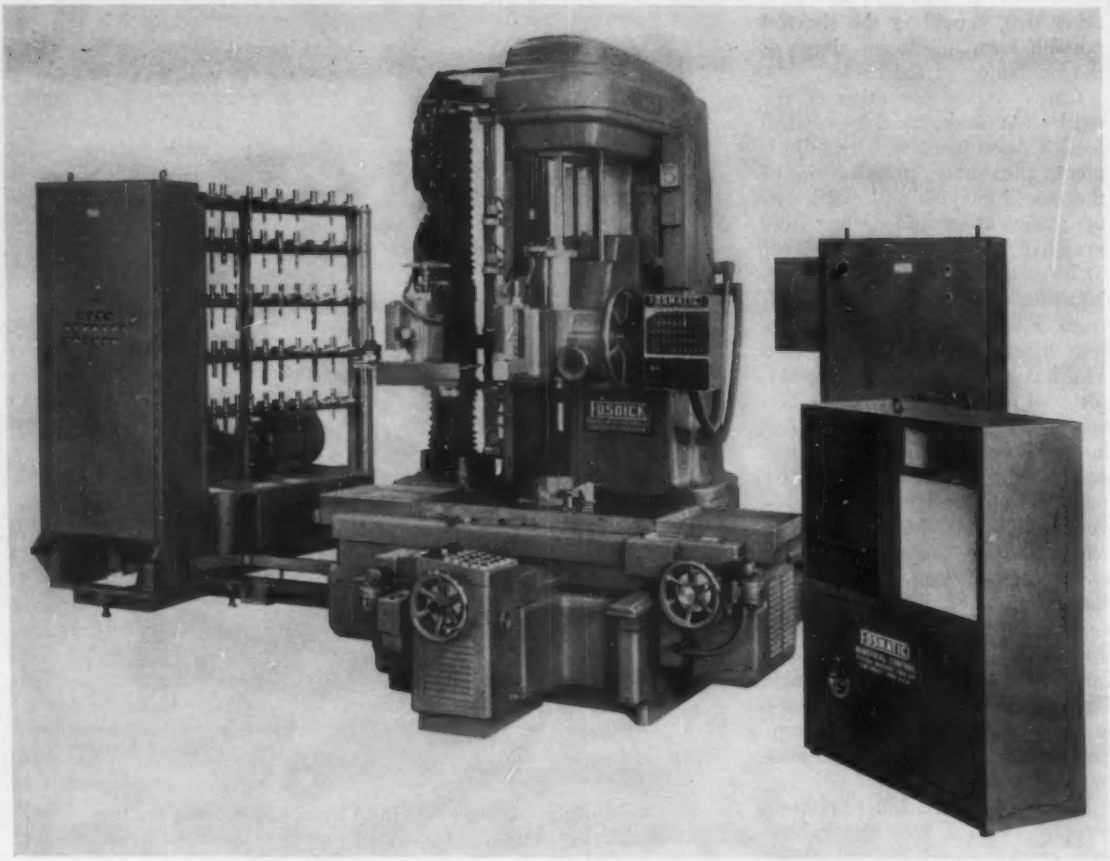


Fig. 2. No. 2 1/2-4 gear-hobbing machine introduced by Barber-Colman

Fosmatic Precision Boring Machine with Tape Control, Automatic Tool Changing

Numerical control and automatic tool changing highlighted the Machine Tool Exposition exhibit of Fosdick Machine Tool Co., Cincinnati, Ohio. The showpiece of the Fosdick line was the new Fosmatic 54-P precision boring machine here illustrated. This machine was displayed complete



Tape control and automatic tool changing are features of this Fosmatic precision boring machine

with tape control of saddle, table, spindle speeds and feeds, spindle depth, head, and automatic tool changing.

The Fosdick tape control system is electromechanical with all its off-machine components housed in a single small console. It establishes head height and depth of cut through a built-in system of Class A gages similar to that used in the Fosmatic "Direct Dimensioning Measuring" device. Head height and depth control make it practicable to use tools of random length on this numerically controlled precision boring machine. The automatic tool changer holds up to 100 boring, drilling, and end-milling tools. It is controlled from the tape-control console which positions and controls the machine.

Also displayed at the exposition were the all-new Fosmatic 32 and 42 jig borers and jig grinders. The Fosmatic 32 PG jig grinder featured automatic positioning of the table and saddle. The 42P jig borer was shown equipped with Direct Dimension Measuring, first introduced at the 1955 Machine Tool Exposition in Chicago on the 44 and 54 Fosmatics.

The Fosmatic 44PG jig grinder was featured for the first time with a "Pre-Select" dial control for positioning of the table and saddle. The Pre-Select console of this control is provided with plug-in connectors and can be readily disconnected and replaced with a tape-control console. This feature makes it possible to have one tape control to operate either the jig borer or jig grinder.

Fosdick's new three-axis, thirty-two-spindle, numerically controlled turret drill presented a new approach to production drilling. This machine has thirty-two spindles in a vertical plane and is operated from a single speed and feed transmission. Spindles are automatically controlled from tape information as to proper speeds and feeds and depth of cut. The table, which is tape-controlled, is offered in several sizes to suit individual requirements.

A smaller, sensitive two-axis drill with numerical control was also displayed. Similar to a "layout" machine in appearance, this drill effectively eliminates the necessity of layout for many drilling operations. Its size (24- by 42-inch table), power (3 hp), and moderate cost put it in the range of almost any plant doing small job-lot drilling where speed and accuracy are important factors.

In addition, Fosdick exhibited a new sensitive drill with variable-speed transmission; also a 5BM sensitive drill with gear transmission. A Fosmatic 6-foot 17-inch radial drill and a 4-foot sensitive radial drill completed the company's exhibit.

Circle 579 on Readers' Service Card

Turret Drilling Machine Added to Avey Line

The newest addition to the line of drilling, tapping, and production machines built by the Avey Division, Motch & Merryweather Machinery Co., Cincinnati, Ohio, is the Model 250 Turret-Dex. This hydraulic, six-spindle turret drilling machine has a power-indexed turret, which makes it possible for many different operations to be performed at one work position. Such operations include drilling, tapping, reaming, boring, countersinking, chamfering, bottom drilling, and deep-hole drilling. The drilling capacity in mild steel is 1 1/4 inches. Each of the six spindles is of rigid, one-piece construction and is equipped with tapered roller bearings. Any spindle may be skip indexed, and all spindles have automatic depth control, with a micrometer adjustment on the depth stops.

The infinitely variable feed rate is from 0 to 120 ipm. All speeds, feeds, rapid advance, and tapping cycles can be preselected on a convenient panel. Six or twelve spindle speeds are available. Turret clamping and push-button indexing of the turret are automatic. Turret spindle travel is 8 inches. The rapid traverse rate is 240 ipm and the clearance from spindle to table is from 8 to 35 inches.

Standard table size is 35 by 20 inches. Numerical control is available with a two-axis positioning table. This table is indexed by standard eight-hole tape which can be punched manually or on a special typewriter. No computer is required for tape programming. Other features of the Turret-Dex include hardened and ground ways, a centralized control panel, and an efficient oil-mist type of lubricating system.

Circle 580 on Readers' Service Card

Kent-Owens Hydraulic Milling Machine

An improved milling machine with a 24-inch table travel is a recent addition to the line of metalworking equipment made by the Kent-Owens Machine Co., Toledo, Ohio. This No. 2-24 hydraulic milling machine, built in both single- and double-spindle models, was introduced and demonstrated for the first time at the Machine Tool Exposition. New features include improved hydraulic control for both climb and conventional milling. Feed controls, for example, have built-in heat compensators which provide for a more constant rate of feed. The machine table is 48 by 12 inches and has a 24-inch travel. The operating cycle is fully automatic. A 5-hp spindle motor is furnished as standard, but a 7 1/2-hp motor can be supplied.

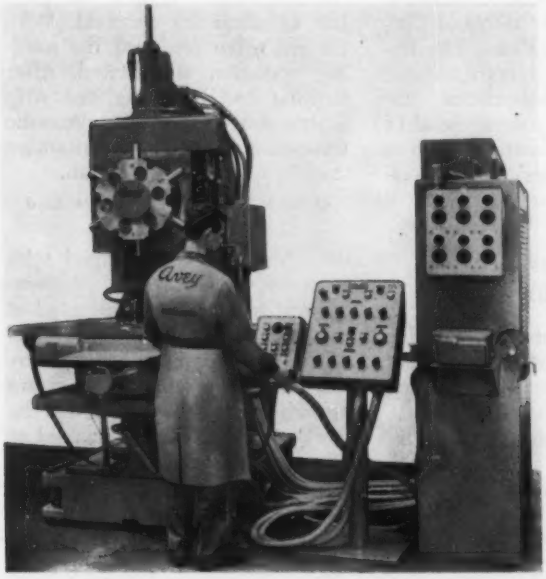
The table of the 2-24 can be fed at 3/4 to 60 ipm or rapid traversed at 340 ipm in either direction, automatically shifted from rapid traverse to feed in either direction, and automatically reversed at the ends of the stroke. It may be automatically stopped at any desired point in its travel.

The company also displayed their No. 3-36 and No. 1-14 hydraulic milling machines complete with tooling. The 3-36 has a 36-inch table travel and a 64- by 16-inch table, while the 1-14 has a 14-inch table travel and 32- by 9-inch table. Both machines have fully automatic table feed. This entire group of Kent-Owens milling machines is designed especially to handle both high-production and short-run work.

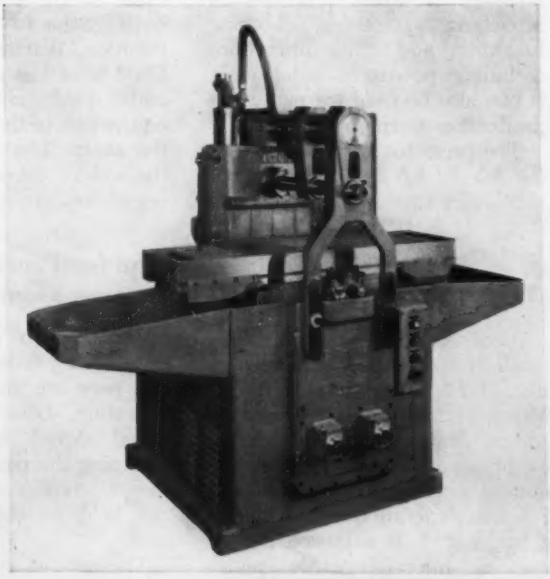
Circle 581 on Readers' Service Card

Versatile Hydraulic Production Presses

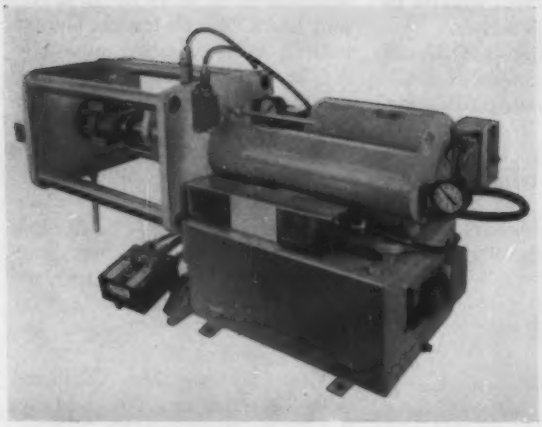
Poly-Standard Industries, Forest Park, Ill., has brought out a Model 41 pendant-controlled hydraulic press of unusual design.



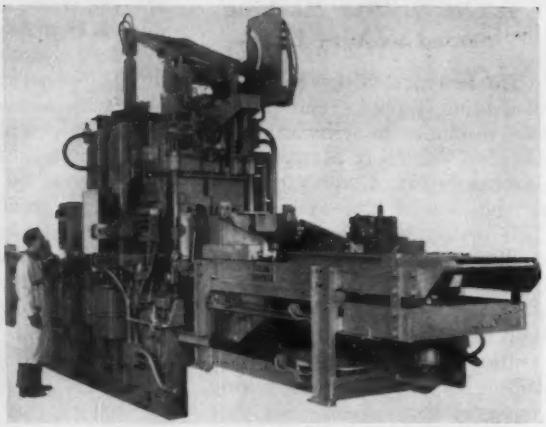
Turret-Dex hydraulic turret drilling machine



Kent-Owens No. 2-24 hydraulic milling machine



Poly-Standard hydraulic production press



Taylor-Winfield butt welder and trimmer

This machine has a second cylinder which can be operated in sequence with the main cylinder. The second cylinder may be used for "holding" or for other slide operations. There is also a manifold outlet for an electrical pressure switch (optional). The pendant control provides complete command of the press from manual through completely automatic operation. This control solves the problem of "maintained contact" on three-position valves.

The wide range of operations which can be performed on this press include assembling, ballizing, coining, deep-drawing, embossing, forming, burnishing, broaching, stamping, bulging, blanking, and other operations, including powdered-metal work. It can also be used for many preproduction purposes.

The press has a daylight opening 6.5 by 8.5 by 10 inches and a cylinder stroke of 11 inches. It is available in eight models with ram speeds ranging from 240 to 12.5 inches per minute and force ratings of from 0.86 to 7 tons.

Circle 582 on Readers' Service Card

Butt Welder and Trimmer for Pipe Skelp

In a continuous tube mill, one coil of flat skelp (up to a maximum size of 0.337 inch by 20 inches wide) is joined by welding to the next. This process is capable of high production. The strip is flash butt-welded and the flash trimmed off in a rapid, automatic cycle on the machine illustrated, built by the Taylor Winfield Corporation, Warren, Ohio. The finished joint has a smooth surface, and weld characteristics are equivalent to the parent metal of the skelp. The illustration shows the welder, trimmer, and traversing clamp arranged for use in a line with the skelp travel from left to right.

Before clamping the strip for welding, the ends are run against a gage or space bar, which is inserted between the welding dies to assure that the proper amount of strip projects from the dies for welding. This bar also carries hardened steel cleaner blocks to remove flash which has adhered to the vertical die surfaces. Strip-centering devices help to properly align the head and tail ends of the strips to be joined. After the strips have been clamped in position, the welder opens up slightly to release the pressure of the strip ends against the gage bar to allow its removal. With the space bar removed, the welding operation is initiated. After flashing and upsetting, the strip is transferred by an automatic traversing clamp to a trimming station, for removal of flash.

Circle 583 on Readers' Service Card

Precision Boring Machine for Processing Aluminum Gear-Box Frame Assembly

A precision boring machine, the smallest in the range produced by Ex-Cell-O Corporation, Detroit, Mich., utilizes the latest multiple-spindle design in boring a total of twenty-two holes in a small aluminum gear-box frame assembly. Efficient operation of this machine, Fig. 1, is achieved by the use of interchangeable plates carrying multiple spindles.

The work-piece, Fig. 2, is finish-bored in two setups. The five larger holes shown on one side of the part are bored at the first operation. Locating from established dowel holes and hand clamping the part in a simple fixture, tolerances on hole diameters are held to size within 0.0005 inch.

The second operation involves boring from both sides, the original spindle plate being quickly detached and interchanged with a seven-spindle plate. A ten-spindle component is mounted at the other end of the machine. After one lot is rapidly bored by this method, bronze bushings are assembled in the holes in the work-pieces, tools are changed at the machine, and the operation is repeated.

These work-pieces were formerly bored in a toolroom setup requiring a full day to complete one part. Now they are finished in a matter of minutes. Several pre-

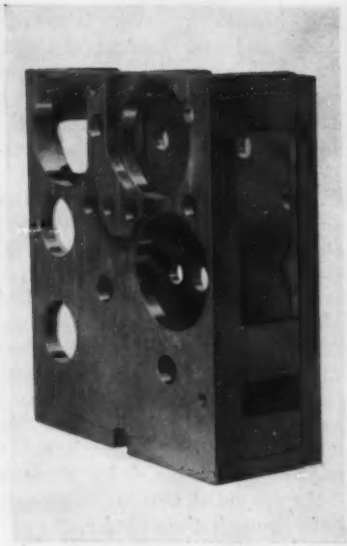


Fig. 1. (Left) Ex-Cell-O Style 712 precision boring machine. Fig. 2. (Right) Aluminum gear-box assembly processed on machine shown in Fig. 1

cautions are taken to ensure consistent accuracy, one of which is the holding of the spindle plates at a constant temperature.

Circle 584 on Readers' Service Card

Piercing, Notching, and Blanking Press

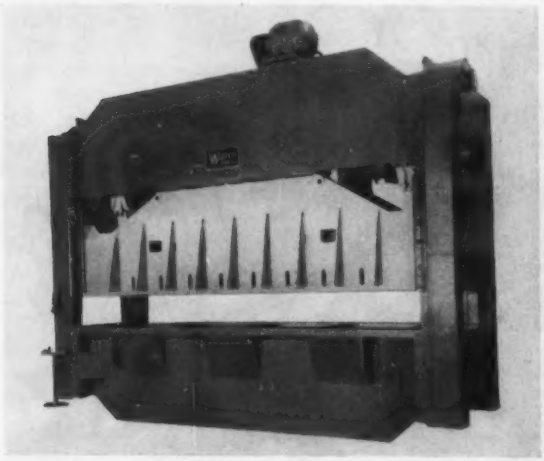
A double-crank, double-back-geared, twin-drive, straight-side press has recently been introduced by the Warco Division of the Federal Machine & Welder Co., Warren, Ohio, to handle piercing, notching, and blanking work. This press was originally designed for piercing and blanking operations on aluminum parts made in large quantities by a leading manufacturer. Of welded steel construction, the press is designed to offer high rigidity and strength of frame. It has a capacity rating at a point near the bottom of the stroke of 500 tons.

The steel frame is of four-piece bolted construction. Clear distance between housings is 240 inches. The slide is 72 by 240 inches and has a stroke of 12 inches. The machine requires a floor space approximately 130 by 288 inches, and weighs approximately 220,000 pounds. It operates at thirty strokes per minute, and is equipped with a Warco pneumatic clutch and brake with electrical clutch control. Similar presses are available in capacities ranging from 100 to 800 tons.

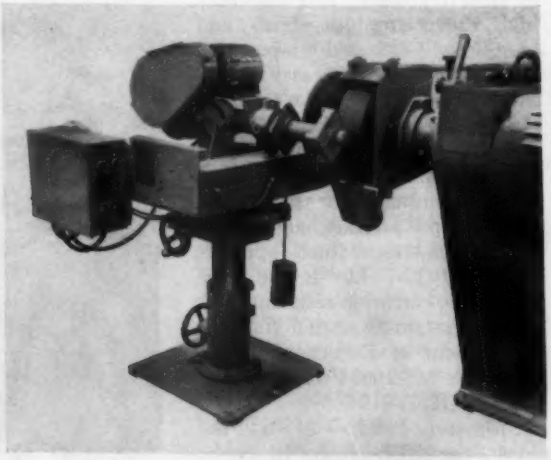
Circle 585 on Readers' Service Card

Work-Holding Machine for Polishing and Buffing Operations

A machine, especially designed to hold other than round workpieces while they are being polished or buffed by regular lathe or abrasive-belt machines, is now



Warco straight-side piercing, notching, and blanking press



Hammond automatic machine for use in polishing operations

offered by Hammond Machinery Builders, Inc., Kalamazoo, Mich. Designated the Hammond cammed junior automatic Model EPC, this machine is easily adjusted to hold round parts as large as 14 inches in diameter.

Circle 586 on Readers' Service Card

Truarc Retaining Rings Made of High-Strength Stainless Steel

Armco PH 15-7 Mo, a new high-strength, precipitation hardening stainless steel possessing many outstanding room temperature and elevated temperature mechanical properties is now being offered as an additional material for the complete line of Waldes Truarc retaining rings made by Truarc Retaining Rings Division, Waldes Kohinoor, Inc., Long Island City, N. Y.

PH 15-7 Mo was selected after extensive testing conducted in cooperation with Armco Steel Corporation, Middletown, Ohio. It offers the following unusual combination of advantages: good corrosion resistance—comparing favorably with the 300 series stainless steels; minimum distortion when hardened by low-temperature heat-treatments; high ultimate tensile strength—with a minimum of 225,000 psi; high strength-weight ratios that make possible strong, heat-resistant retaining rings with minimum weights; high short-time elevated-temperature tensile properties up to 1000 degrees F; and unusually high creep strength—short- and long-time elevated-temperature from 600 to 100 degrees F.

These properties make this new steel one of the most outstanding materials available for withstanding the combination of stresses and heat encountered in supersonic missiles and aircraft, and many other high-temperature applications. PH 15-7 Mo is the only acceptable corrosion-resistant steel listed for retaining rings in the new Department of Defense Military Standards MS-16624 through MS-16634, MIL-R-21248.

Ultimately PH 15-7 Mo will replace Type 420, heretofore the only grade of stainless steel used in the manufacture of Truarc retaining rings. (Type 420 will continue to be available for a limited time for high-temperature applications where good corrosion resistance is not a requirement.)

In addition to aircraft and missiles, Truarc retaining rings made of PH 15-7 Mo are especially suited for use on food and beverage processing and dispensing equipment, photographic processing equipment, household appliances, and marine equipment and other outdoor applications.

Circle 587 on Readers' Service Card

Long-Bed 10-Inch Lathe

A "long-bed" Delta 10-inch metal-cutting lathe, with a capacity of 36 inches between centers, has been introduced by the Rockwell Mfg. Co., Delta Power Tool Division, Pittsburgh, Pa. This lathe features the variable-speed drive, 3/4-inch collet capacity, and all other features of Delta's standard 10-inch metal lathe introduced last year. It is designed to fill the need for a low-cost, compact, easily operated lathe to do heavy-duty work in commercial metalworking shops, plant maintenance shops, and toolrooms.

Two new safety accessories make this lathe particularly applicable for school shops. They are: a magnetic starter, electrical disconnect switch kit which automatically shuts off the motor when the headstock cover is swung open; and a mechanical back-gear lock-out kit which protects the gears of the headstock because it forces the operator to raise the headstock cover before the back-gears can be engaged.

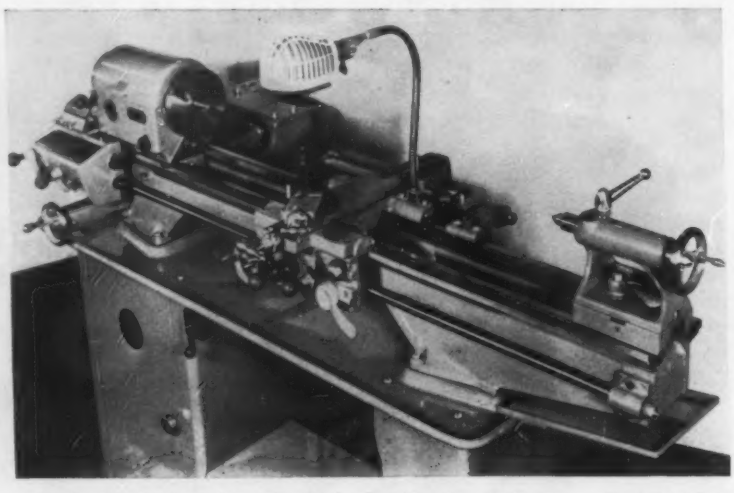
The variable-speed drive gives the operator the advantages of infinitely variable speed from 50 to 1500 rpm plus the high torque transmitting power of matched V-belts in the final drive to the spindle. The smooth, quiet, direct drive position can be used extensively for many thread pitches and heavy cutting usually done in gear drives. The 3/4-inch collet capacity is obtained by using a 4-C style collet with a 15/16-inch hole through the spindle.

Other important features include: a quick-change gear-box that provides a choice of fifty-four feeds or thread pitches, apron clutch which allows an infinite choice of power transmission, and variable-speed drive whose high- and low-speed ranges can be preset on the job in direct or gear drive. The lathe is used with a full 3/4-hp motor.

Circle 588 on Readers' Service Card

Mattison Chain-Feed Double-Disc Grinder

Rigidity, positive spindle feed, and 50-hp spindle-drive motors make it possible to remove stock at high speed on a chain-feed,



Long-bed lathe introduced by Rockwell Mfg. Co., Delta Power Tool Division

Mattison chain-feed double-disc grinder with automatic feed designed to handle parts of different lengths in the same production run

double-disc grinder introduced by the Mattison Machine Works, Rockford, Ill. Up to 5 cubic inches of stock per minute were removed in production tests recently conducted on this new machine. A unique feature of Mattison's new chain-feed mechanism employed on this grinder is its "disappearing link" principle. This permits work-pieces in a variety of sizes to be fed into the machine without adjustment or change in the loading and feeding mechanism shown in the illustration. Closely spaced drive links drop into neutral position when interference pressure from the work-piece is applied, leaving any free succeeding link to drive the part. Thus, it is possible, and practical, to feed a variety of different sized parts in the same production run.

In grinding chain-saw guides made of high-carbon steel, total stock removal of 0.015 inch is accomplished in a single pass on this No. 120 double-disc grinder at a feed rate of 8 fpm. This is equivalent to the removal of 5 cubic inches of stock per minute. Size is held to 0.002 inch; and parallelism—end to end, or side to side—is held to 0.001 inch.

A dial indicator shows when wheel wear approaches size limits. To compensate for wear, a ratchet-operated feed, powered by an air cylinder, can be actuated manually by the operator in accordance with size control indicator readings. The grinder uses 30-inch cylinder wheels, features an extra-rigid wheel mounting, and a positive feed screw mechanism that eliminates all deflection from the work-piece. This assures positive cutting action and exact size control.

Circle 589 on Readers' Service Card

New Vibration Isolators Resist Wider Heat Range

Three new high- and low-temperature shock and vibration isolators for electronic and industrial equipment designed to handle static loads from 1/2 pound to 25 pounds have been added to the Isomode line manufactured by MB Electronics, New Haven, Conn. These new products were a feature of the display of this division of Textron Electronics, Inc., at the recent Production Engineering Show in Chicago. Isomode high- and low-temperature mounts retain their effectiveness at continuous temperatures ranging from minus 100 to plus 500 degrees F. They consist of two load-carrying springs, mounted in opposed directions, with a built-in damper assembly to restrict resonant build-up.

Springs for the isolators are made of aircraft quality chrome-vanadium steel. Other metallic elements are fabricated from passivated stainless steel. The three new isolators conform to dimensions set by Army-Navy Aeronautical Standard AN8008 series vibration-insulator specifications.

The use of vibration-absorbing mounts or pad as an integral part

of a machine installation can increase operator productivity from fifteen to thirty minutes per day while contributing a 25 to 40 per cent increase in machine service life. Maintenance is reduced because of less wear and tear on machinery and the building itself. Isolation improves the quality of precision finishing operations by preventing external vibration from affecting delicate machine tools.

Circle 590 on Readers' Service Card

Fig. 1. Impact extrusion press that produces 120 aluminum cans per minute

Press for Impact Extrusion of Aluminum Cans

Seamless aluminum cans can be impact-extruded at the rate of 120 per minute by the 300-ton impact extrusion Maxipres shown Fig. 1. Developed by the National Machinery Co., Tiffin, Ohio, for use in a brewery, this press delivers beer cans in an oriented manner ready for trimming, flanging, cleaning, coating, filling, and closing. Each can (Fig. 2) is extruded from a disc 1/8 inch thick and 2 1/2 inches in diameter and has a height of over 5 inches as it emerges from the machine.

The press, which weighs 48,000 pounds, has a cast-steel bed-frame capable of absorbing the shock of

Fig. 2. Aluminum blank and can impact-extruded from the blank by machine shown in Fig. 1

extrusion. A simple adjustment of the die will vary the bottom thickness of the can while the press is running, and an indicator shows the tonnage generated during the machine cycle. Safety features guard against any malfunction of the press.

A 50-hp motor drives the machine and an air diaghragm clutch is employed. The slugs are punched from cast strip aluminum and delivered to the die by a vibratory hopper feed. A Geneva mechanism operates the discharge conveyor which orients the cans for the next operation. An automatic air-operated band brake is employed and safety devices stop the press if no blank is delivered or if an extrusion is not stripped from the punch. Wax lubricant is used.

Circle 591 on Readers' Service Card

Davis Improved Line of Kwik-Size Boring Tools

An enlarged and improved line of Kwik-Size three-in-one boring tools is announced by the Davis Division, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Designed to speed boring operations by eliminating the need for different tools for roughing, semi-finishing, and finishing, the Kwik-Size tools are available in eighteen sizes for boring holes in ranges from 3 to 13 1/4 inches in diameter. The tool carries three standard square cutters in a single indexable head. The cutter-head is mounted eccentrically on an arbor so that one tool is in the cutting position and the other two are clear of the bore.

To index from one cutter to the next, the operator simply loosens a clamping nut one-half turn and rotates the head. Eccentric mounting of the head brings the next cutter into the proper cutting position. Tightening of the clamping nut readies the boring tool for the next operation. This simple method of indexing from one cutter to the next permits successive

Kwik-Size boring head for rough, semifinish, and finish boring

operations without disturbing the work-piece or removing the arbor from the machine spindle. A micrometer type setting gage, available as optional with the boring head line, permits cutter setting to 0.001 inch with the tool mounted in the machine.

Circle 592 on Readers' Service Card

Baird Spring Generator Also Forms End Loops

A machine, unique in that it can form a spring and both end loops complete in a single cycle, has been introduced by the Baird Machine Co., Stratford, Conn. Called a spring generator, this equipment has many applications in industries manufacturing springs, clips, clamps, coils, and related products of wire having diameters between 0.008 and 0.034 inch.

The machine can make many types of springs and various kinds of end loops, including extended hooks. In addition, the loop formed on one end can differ from that on the other in both size and type. Production rates obtainable with the variable-speed drive of the machine are from 720 to 6400 pieces per hour. A load tolerance of plus or minus 5 per cent can be maintained. The machine weighs 420 pounds and occupies a floor space of 22 by 27 inches exclusive of the wire reel. Standard equipment includes a pedestal type base, five sets of feed change-gears for feed lengths of from 0 to 26 inches, one set of standard cams, one set of standard cam inserts for extended hook springs and torsional springs, one quill setting gage, and one set of gear and belt guards.

Also obtainable as extra equipment are one set of tools for each wire size, one high-speed steel cut-off tool (used for all wire sizes), and one pair of hardened steel feed rolls for each wire size.

Circle 593 on Readers' Service Card

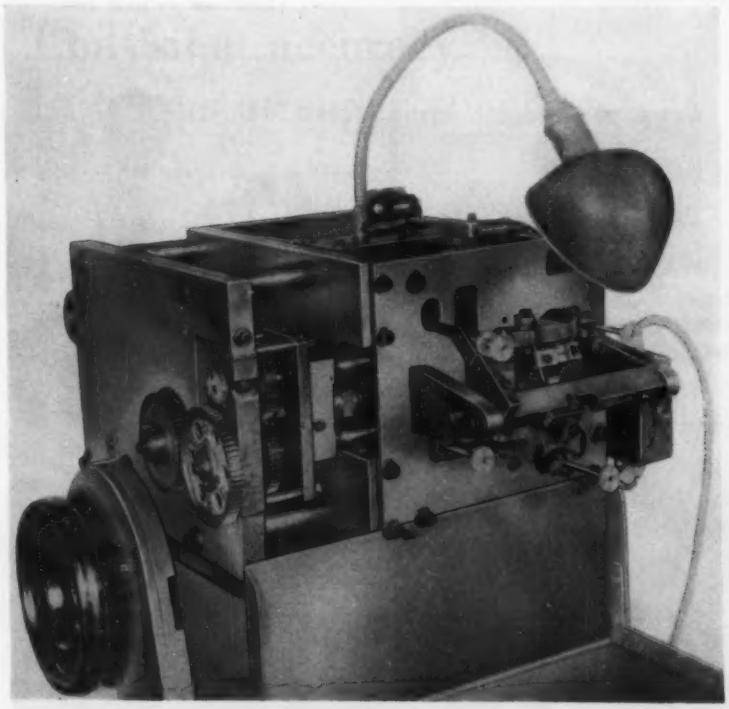
Universal-Automatic Drilling, Tapping, and Threading Machine

A high-speed, fully automatic triple-spindle machine has just been designed by the Universal-Automatic Corporation, Schiller Park, Ill. This versatile machine has been developed to speed up the production of secondary operations on screw machine and headed parts, die castings, stampings, and molded plastic parts. It has two horizontally opposed spindle units and one vertical spindle unit. Each can be cycled individually and automatically, in any combination with the other two units, allowing varied sequence to suit the job.

Each unit has an individual spindle drive motor with speeds ranging from 500 to 10,000 rpm, thus enabling each spindle to run at the proper speed for the operation being performed. Dovetail mounting permits 11-inch major adjustment of individual heads plus 2 1/2-inch spindle stroke control. Each spindle is advanced and retracted by twin double-acting air cylinders complete with intake- and exhaust-air metering controls, air pressure regulator, and gage, operating on shop air supply (15 to 100 psi as required). The electrical control circuit is 110 volts. The machine has a capacity for drilling 0.020- to 3/8-inch holes or for tapping up to 3/8-inch threads in mild steel.

Clamping fixture air outlet, pressure regulator, gage, and fixture-synchronizing stations employing plug-in jacks are also provided. With the addition of hopper and chute this triple-spindle machine can be run as a fully automatic, or automatic with hand-fed magazine which permits the operator to feed parts continuously during the entire machine operating cycle.

Circle 594 on Readers' Service Card



Close-up of Baird spring generator showing change-gears and tool area

Coolant for Medium-Duty Cutting and Grinding

A coolant developed to provide greater production economies in medium-duty cutting and grinding has been announced by Shear-Speed Chemical Products, division of Michigan Tool Co., Detroit, Mich. This premium quality oil, known as H-114, is an addition to the company's line of high-grade coolants and cutting oils, and has been thoroughly field-tested on many diversified operations. It has a sulphur-chlorinated base and is said to provide exceptionally fine finishes for many operations and for the machining of many metals.

Because the oil does not have to be changed between operations, outstanding savings are effected. The new coolant also fea-

tures good body combined with excellent chip-settling properties and low carry-off. It is said to prevent wheel load-up, stay free cutting, require less dressing, and to cool as it lubricates under extreme pressures. Thus, it increases tool life and permits operation at optimum feeds and speeds.

Circle 595 on Readers' Service Card

Vacu-Matic Filters for Coolants

Following extensive research and development as well as on-the-job application, an entirely new, fully automatic, high-capacity Vacu-Matic filter for handling water-soluble oil coolants in quantities from 200 to 2500 gallons per minute is now available from the U. S. Hoffman Machinery Corporation, New York City. The use of this filter in grinding and machining operations is said to make possible higher speeds, faster feeds, and better finishes.

The new filter is simple in design and suitable for all grinding and machining operations using water-soluble oil coolants. Operation is entirely electrical and continuous without the use of solenoids, air cylinders, or control valves. Paper is indexed automatically, making shut-off of dirty coolant through the filter unnecessary. Separation of spent filter paper, sludge, and chips is entirely mechanical. Through the process of aeration, coolant remains constant at or below ambient room temperature. Coolant sweetness is said to preclude the possibility of bacteria growth. Another unusual design feature of the Hoffman Vacu-Matic is reduction of the size of the service tank. Gravity feed of dirty coolant to filter is possible where plant layouts permit.

Circle 596 on Readers' Service Card

Cincinnati Flamatic Equipped for Hardening Automotive Stator Hubs

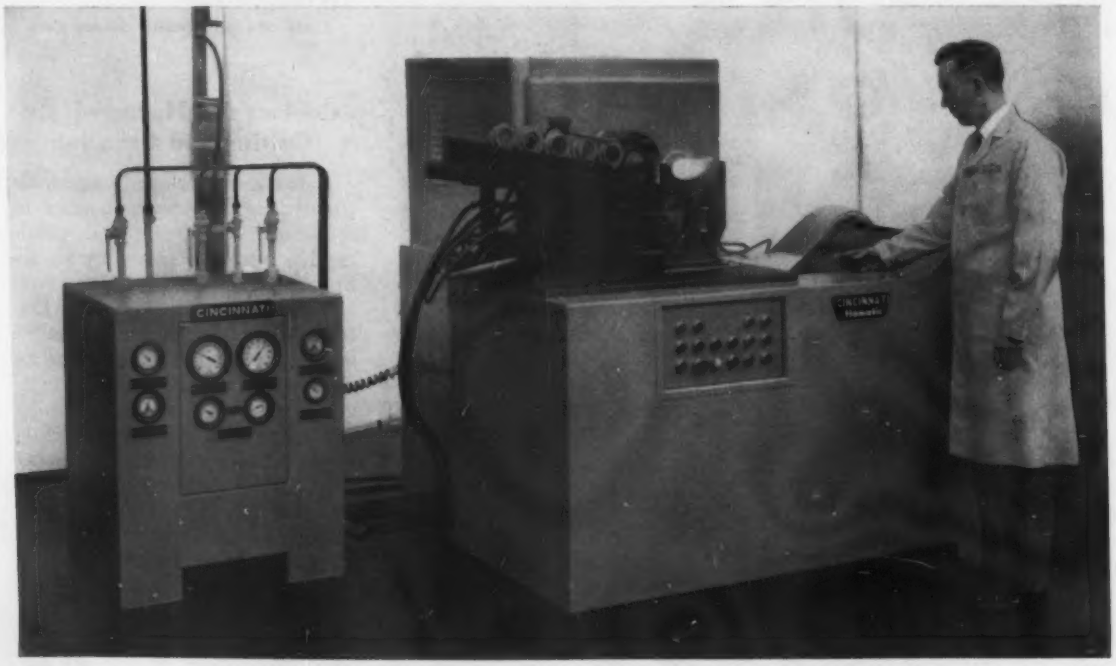
The Meta-Dynamics Division, Cincinnati Milling Machine Co., Cincinnati, Ohio, has brought out a No. 3 Flamatic equipped with water-cooled rotary flame head for hardening automotive stator hubs. The Flamatic unit (shown at the right in the illustration) is provided with the new, compact, low-cost gas-control cabinet shown at the left. The latter unit regulates fuel gas and oxygen and includes accommodations for air and water.

The automotive stator hub hardened by this equipment has an outside diameter of 3.94 inches and an inside diameter of 2.157 inches. It is made of SAE 1062 steel and has its inside bore hardened to 60-62 Rockwell C to a depth of 0.125 inch. Production is at the rate of 208 parts in fifty-two minutes.

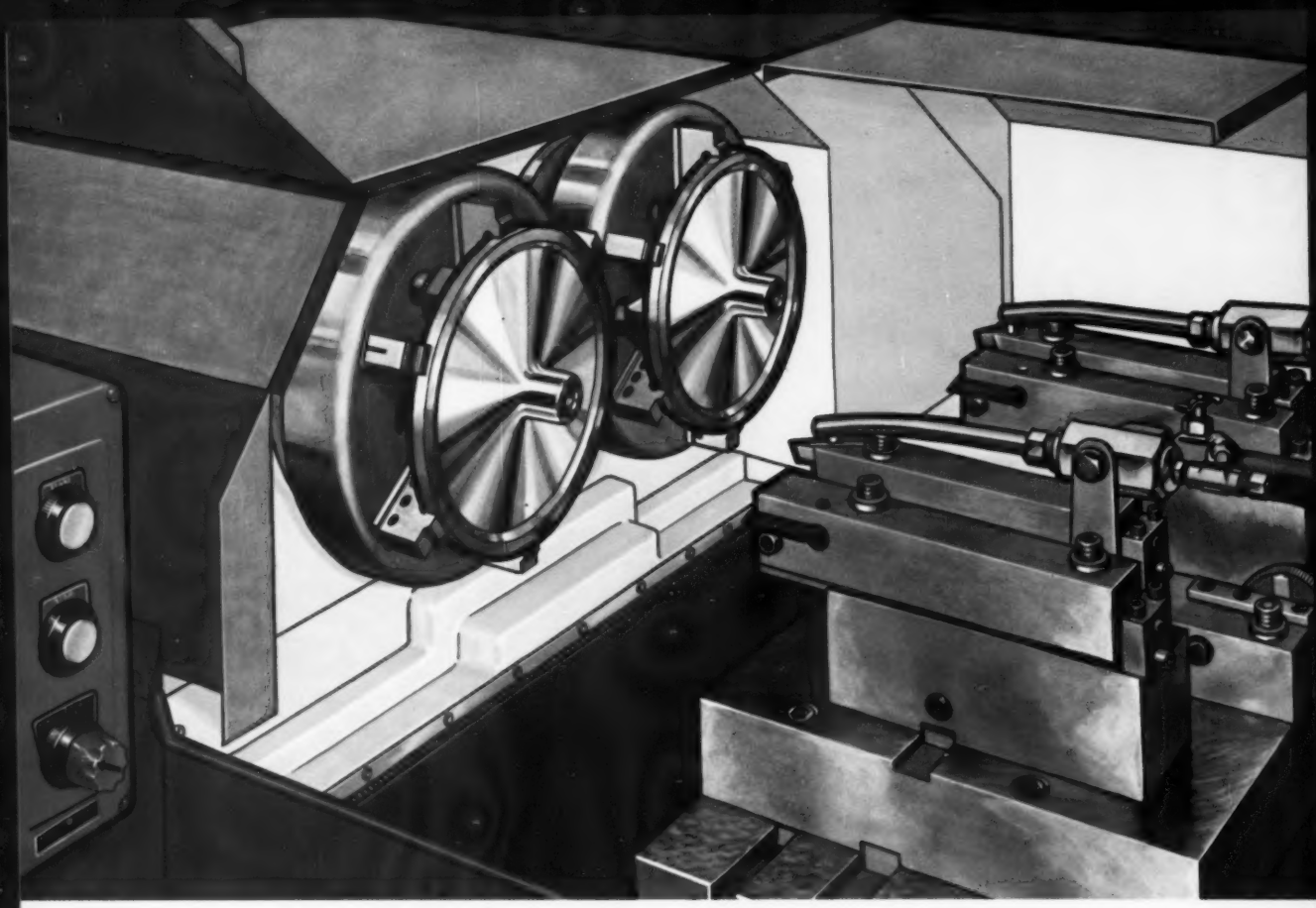
The part is fed by gravity down an inclined chute and located on a cradle type fixture in front of the rotary flame head. The flame head advances into the part bore and rotates, selectively heating the inside diameter. At the completion of the heating cycle, the flame head retracts, the cradle tips forward, and the part is dropped into an integral quench tank. A conveyor carries the part out of the tank.

Circle 597 on Readers' Service Card

(*Continued on page 194*)



Cincinnati equipment arranged for hardening automotive stator hubs



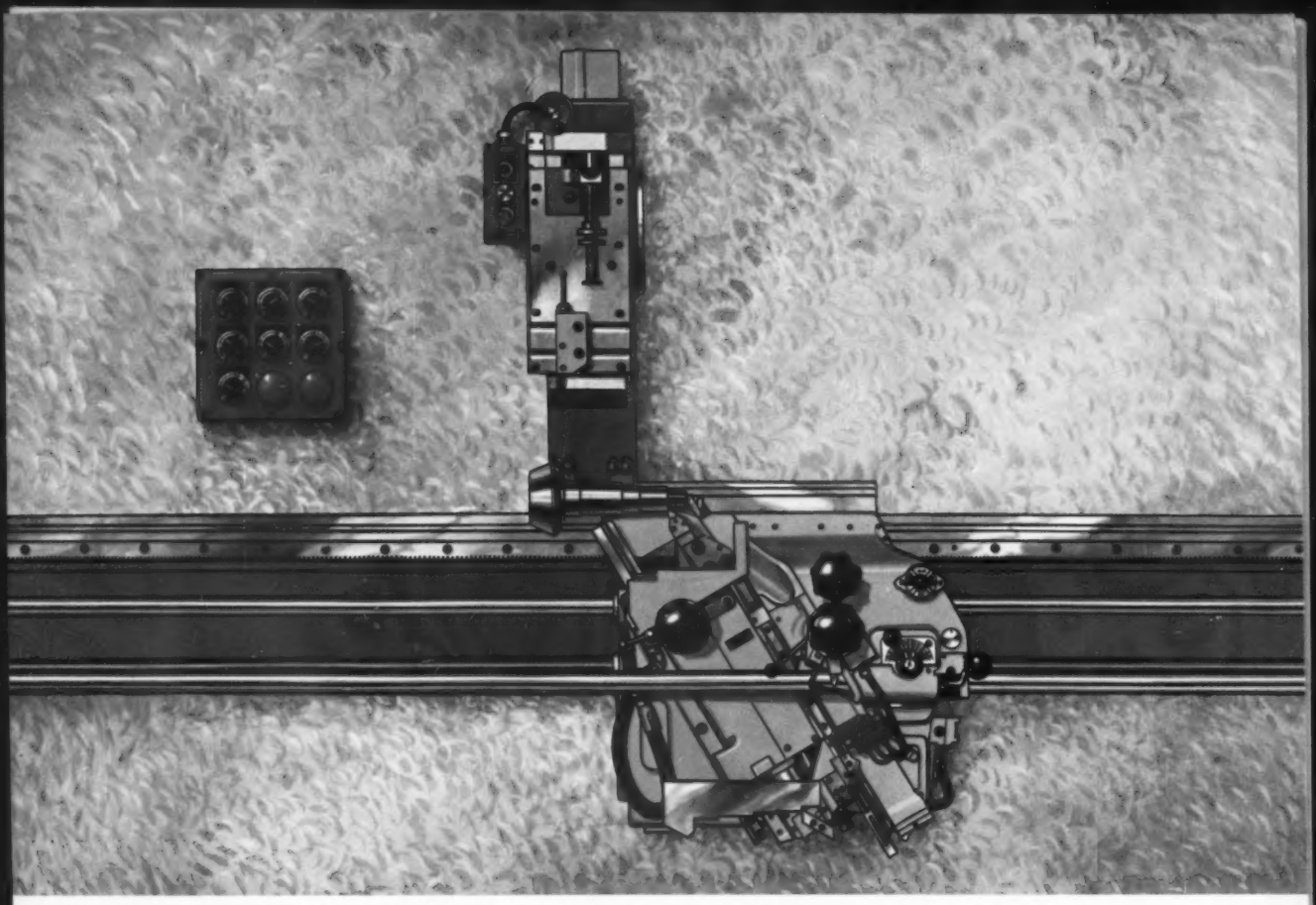
Consistent accuracy to tenths at super speeds

Model 37 Precision Boring Machine is a machine with a mission, rather than an answer to everybody's metal turning problems. Its mission is contour boring and turning in applications where both extreme repetitive accuracy and high production are of paramount importance. If you have such a requirement, Model 37 is an unbeatable money-maker.

It is an inherently simple machine: simple to operate, with inspection limited to gauging any one dimension. Simple in operating principle, too, built around precision cams that operate without being affected by temperature fluctuation. From one to four high speed spindles can be mounted on a single machine.

We would be happy to discuss *any* production problem involving straight or contour boring and turning. We doubt that anyone equals New Britain's know-how in this area, and we have a wide variety of boring equipment, both vertical and horizontal and of very advanced design. No matter what your work, or production requirements, this is a very fine place to look for an answer. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division · New Britain, Connecticut



Fast, rugged New Britain +GF+ copy lathes

Right from the ground up the New Britain **+GF+** is a machine conceived, designed and manufactured as a copying-contouring lathe. Not a standard lathe with copying attachment; not a factory-made "special" with the contouring feature built on components from other lathes; but a solidly based, ruggedly constructed, fast, powerful, accurate machine designed solely for the template-controlled, rapid production of between-centers or chucked work with external or internal contouring.

A million pieces or just a few, it's a machine you'll use on many different types of short-run jobs (just change the template and reset the controls), or on one long-run job (just replace the single-point tool when it wears).

The instantaneously accurate hydraulic copying mechanism is entirely enclosed within the compact carriage. All controls are within easy reach. The template is up front for easy adjustment. The chips fall free into the wide open base, can't clog or jam any part of the mechanism.

There are endless variations available within the New Britain **+GF+** line. The standard model has applications anywhere on between-centers or chucked pieces. Other attachments and models are available to suit your particular requirements; infeed attachments, automatic loading, bar stock models, etc.

Don't buy any lathe or "special" for copy turning until you have investigated the New Britain **+GF+** copy turning lathe. As a starter, may we send you the latest catalog?

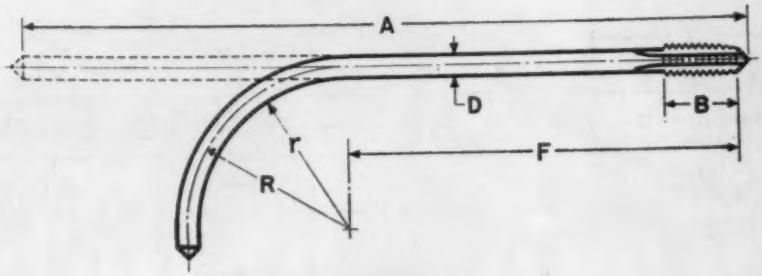
THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division - New Britain, Connecticut

AMERICAN STANDARD CUT AND GROUND THREAD TAPS—21

Bent Shank Tapper Taps

(Machine Screw Sizes)

Carbon Steel—Cut Thread



General Dimensions

Size	Basic Major Diameter	Size of Machine	Threads per Inch			Number of Flutes	Dimensions					
			NC	NF	NS		A	B	D	F	R	r
4	0.112	1/8	..	..	36	3	3 9/16	11/32	0.076	1 25/32	7/8	0.837
4	0.112	1/8	40	..	..	3	3 9/16	5/16	0.080	1 25/32	7/8	0.836
4	0.112	1/8	..	48	..	3	3 9/16	1/4	0.085	1 25/32	7/8	0.832
5	0.125	1/8	40	..	..	3	3 9/16	5/16	0.093	1 25/32	7/8	0.829
5	0.125	1/8	..	44	..	3	3 9/16	9/32	0.095	1 25/32	7/8	0.827
6	0.138	1/8	32	..	..	3	3 9/16	3/8	0.095	1 25/32	7/8	0.827
6	0.138	1/8	..	40	..	3	3 9/16	5/16	0.104	1 25/32	7/8	0.823
6	0.138	3/16	32	..	..	3	4 15/16	3/8	0.095	2 15/32	1 3/16	1.140
6	0.138	3/16	..	40	..	3	4 15/16	5/16	0.104	2 15/32	1 3/16	1.136
8	0.164	3/16	32	..	..	3	4 15/16	3/8	0.121	2 7/16	1 3/16	1.127
8	0.164	3/16	..	36	..	3	4 15/16	11/32	0.126	2 7/16	1 3/16	1.125
10	0.190	3/16	24	..	..	3	4 15/16	1/2	0.134	2 13/32	1 3/16	1.121
10	0.190	3/16	..	32	..	3	4 15/16	3/8	0.147	2 13/32	1 3/16	1.114
12	0.216	3/16	24	..	..	3	4 15/16	1/2	0.157	2 3/8	1 3/16	1.109
12	0.216	3/16	..	28	..	3	4 15/16	7/16	0.165	2 3/8	1 3/16	1.105
6	0.138	1/4	32	..	..	3	6 1/2	3/8	0.095	3 23/32	1 1/4	1.202
6	0.138	1/4	..	40	..	3	6 1/2	5/16	0.104	3 23/32	1 1/4	1.198
8	0.164	1/4	32	..	..	3	6 1/2	3/8	0.121	3 3/4	1 1/4	1.190
8	0.164	1/4	..	36	..	3	6 1/2	11/32	0.126	3 3/4	1 1/4	1.187
10	0.190	1/4	24	..	..	3	6 1/2	1/2	0.134	3 23/32	1 1/4	1.183
10	0.190	1/4	..	32	..	3	6 1/2	3/8	0.147	3 23/32	1 1/4	1.176
12	0.216	1/4	24	..	..	3	6 1/2	1/2	0.157	3 11/16	1 1/4	1.171
12	0.216	1/4	..	28	..	3	6 1/2	7/16	0.165	3 11/16	1 1/4	1.167
14	0.242	1/4	..	..	20	3	6 1/2	19/32	0.172	3 21/32	1 1/4	1.164
14	0.242	1/4	..	..	24	3	6 1/2	1/2	0.183	3 21/32	1 1/4	1.158

All dimensions are given in inches.
Bent shank taper taps are designed for use in automatic tapping machines.
All taps have external center on thread end.

Tolerances

Element	Range	Direction	Tolerance
Length Overall (A)	4 to 14 incl.	Plus	1/16
Length of Thread (B)	4 to 14 incl.	Plus or Minus	3/64
Diameter of Shank (D)	4 to 14 incl.	Minus	0.005

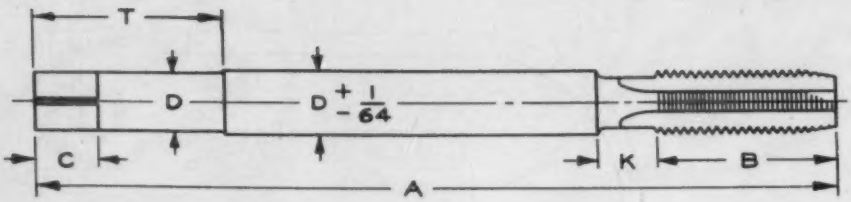
All dimensions are given in inches.

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N.Y.

AMERICAN STANDARD CUT AND GROUND THREAD TAPS—22

Pulley Taps

High-Speed Steel—Ground Taps



General Dimensions

Diameter of Tap	Threads per Inch NC-UNC	Number of Flutes	Dimensions						
			Length Overall A	Length of Thread B	Length of Square C	Diameter of Shank D	Length of Close Tolerance T	Size of Square E	Length of Neck K
1/4	20	4	6,8	1	5/16	0.255	1 1/2	0.191	3/8
5/16	18	4	6,8	1 1/8	3/8	0.318	1 9/16	0.238	3/8
3/8	16	4	6,8,10	1 1/4	7/16	0.381	1 5/8	0.286	3/8
7/16	14	4	6,8,10	1 7/16	1/2	0.444	1 11/16	0.333	7/16
1/2	13	4	6,8,10,12	1 21/32	9/16	0.507	1 11/16	0.380	1/2
5/8	11	4	6,8,10,12	1 13/16	11/16	0.633	2	0.475	5/8
3/4	10	4	10,12	2	3/4	0.759	2 1/4	0.569	3/4

All dimensions are given in inches.
These taps are furnished in plug style in H3 limit only.
These taps have internal center in thread end.

Tolerances

Element		Range	Direction	Tolerance
Length Overall	A	1/4" to 3/4" incl.	Plus or minus	1/16"
Length of Thread	B	1/4" to 3/4" incl.	Plus or minus	1/16"
Length of Square	C	1/4" to 3/4" incl.	Plus or minus	1/32"
Diameter of Shank	D	1/4" to 3/4" incl.	Minus	.005"
Size of Square	E	(1/4" to 1/2" incl.	Minus	.004"
		(5/8" to 3/4" incl.	Minus	.006"

Formulas
(Approximate)

Diameter of Shank "D" = Maximum Major Diameter
Size of Square = Diameter of Shank "D" x .75 to nearest .001"

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N.Y.

WEAR RESISTANT
THOMSON

60 Case

AVOID the HIGH COST and difficulty of fabricating long, hard & straight parts by conventional methods!

hardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

ELIMINATE WEAR and REDUCE COST

60 Case is the result of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining. *Write for literature and name of your local representative.*

For emergency needs call collect
MAnhasset 7-1800

ADVANTAGES of *60 Case*

- COST REDUCTION
- HARD BEARING SURFACE
- NICK-& DENT-PROOF
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

TYPICAL *60 Case* PARTS

GUIDE RODS • SHAFTING • ROLLS • TRAVERSE RAILS
PISTON RODS • ARBORS • LEADER PINS • TIE RODS
KING PINS • AXLES • CONTROL RODS • GUIDE POSTS
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THOMSON INDUSTRIES Inc.
Dept. C-9 Manhasset, New York

PARTS HARDENED to 60 C...
increase life...reduce cost!

Monarch Dyna-Shift Lathe with Pathfinder Control and Mona-Matic Shaft-Finishing Lathe

The Pathfinder is a new system for numerically controlling contour turning announced by the Monarch Machine Tool Co., Sidney, Ohio. It continuously coordinates the relative distance of motion and feed rate of the machine slides in order to produce the contour dictated by the numerical information. In addition, numerical data controls the turret position, coolant on-off, and feed or traverse selections, as well as the selecting of one of eighteen motor speeds within a 4-to-1 range. This permits the programming of any work cycle encountered in normal machine shop practice, so that the operator need only load the machine and depress the start cycle button.

In order to obtain the ultimate in reliability and ease of maintenance, the system combines digital and analog techniques. Digital circuitry is used in the control cabinet, while the feedback is analog. The major elements of the system are the tape reader, director, and servo units. These are housed in a control console, 5 feet in height, requiring a floor space of 36 by 30 inches. The tape reader is provided with a hopper for loop tapes and reels for long tapes, the latter being rewound under power. Operator controls for manually inserting data, as well as other infrequently used controls, are located on this console.

The Pathfinder control system is applied to a Monarch Series 80 heavy-duty Dyna-Shift lathe, Model 2516-20, Fig. 1. Distance between centers on this lathe is 72 inches. The headstock is furnished with thirty-six spindle-speed changes from 10 to 1250 rpm. The main drive motor is 25-hp, variable speed, constant horsepower. Power is secured through an electronic unit in the form of a plug-in module for ease of maintenance.

The arrangement normally used on the Series 80 lathe to supply electric and hydraulic power without carrying along unsightly hoses and conduits is utilized in the same manner on this machine. The only manual controls required on the apron are two zero-shift resolvers. A small panel on the carriage mounts the controls used during operation of the machine. The carriage is powered by a rotary hydraulic motor and the cross-slide by a hydraulic cylinder. Feedback for the longitudinal motion is rack driven. A ball-bearing screw is used for cross-slide feedback. The tailstock contains air pads for ease in positioning along the bed.

Also announced by Monarch is its Model 21 Mona-Matic lathe, Fig. 2, which is designed to finish multiple-diameter shafts on a production basis to precise accuracy and finish tolerances. The work diameter limit is 0.0002 to 0.0004 inch, depending on length. Finish is 40 micro-inches or better.

The entire drive unit is isolated from the machine, the only connection being through a flexible rubber coupling to the headstock spindle. Drive consists of a 20-hp, 4-to-1 variable-speed direct-current motor with all-electronic control. The baseplate on which the motor is mounted is separate from the lathe. Also mounted on this baseplate are the spindle drive control cabinet and the hydraulic power unit for the "Air-Gage Tracer" and the cooling oil. There is a Poly-V belt drive to the spindle drive shaft. Standard spindle speed is 800 to 3200 rpm.

In addition to Air-Gage Tracer control, a system of gaging and automatic tool adjustment is furnished to compensate for tool wear and make allowance for human error. At preset intervals a caliper type gage automatically gages one diameter. It feeds a signal to an electromechanical servo that moves the tracer mounting with respect to the center line of the lathe.

Fig. 1. Monarch Series 80 heavy-duty Dyna-Shift lathe equipped with Pathfinder control system

Fig. 2. Model 21 Monarch Mona-Matic lathe for close-tolerance finishing of multiple-diameter shafts

If the diameter, when gaged, is off size, the servo moves the tracer so that the next part is finished to the correct size. An adjustable counter records the number of parts to be run before indexing the tool to a new tip. When the preset count is reached, an indicating light tells the operator it is time to push the reset button which moves the servo back to the starting point. The operator then indexes the tool tip, takes a short trial cut to permit the servo to adjust the tracer, and continues to turn parts until the counter signals reset again. Should the reset signal be ignored, the lathe will not start on the next part.

Feed range is infinitely variable from 2 1/2 to 20 ipm. Up to six feeds and six speeds may be preselected to become operative automatically at any time during the cycle. Range of diameter that can be gaged is 3/4 inch to 5 inches. Gaging frequency can be every part, every fifth part, every tenth part, or every twentieth part. The number of parts between resets of the tool is infinitely variable from 0 to 400.

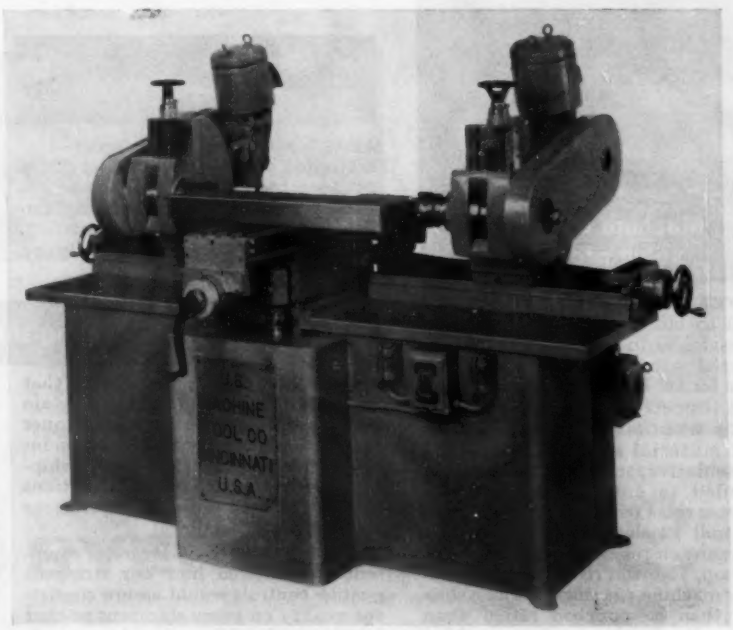
Circle 600 on Readers' Service Card

U. S. Burke "Half Mills"

U. S. Burke Machine Tool Co., Cincinnati, Ohio, displayed new variations of its building-block principle Half Mill at the Chicago Show. The duplex horizontal unit illustrated has extralong slides to permit positioning the two spindles as much as 56 inches apart. This machine mills both ends of long castings simultaneously. Each head is motorized and is driven through a speed reducer.

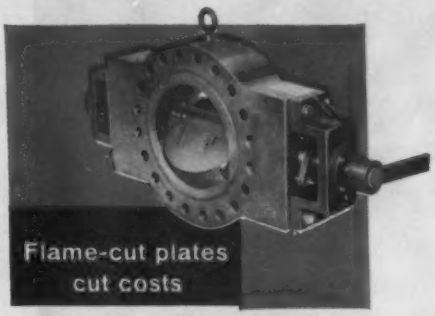
The table, on which the workfixture is secured, can be manually positioned longitudinally. In addition, these micrometer adjustments are provided: independent adjustment of the heads and slides, independent traverse positioning of each spindle, and independent setting of feed stroke and speed. Efficient for slotting, sawing, face milling, keyway cutting, slab milling, boring, and other operations, the machine can be

(Continued on page 198)



U. S. Burke duplex Half Mill with extra-long slides

METALOGICS* IN



HIGH REJECTS: Use of flat steel castings for valve bodies, with I. D. ranging from 4" to 60", accounted for increases in costs for this manufacturer. Pattern costs rose because of numerous changes . . . rejects were high due to porosity and other casting faults that showed up only after machining.

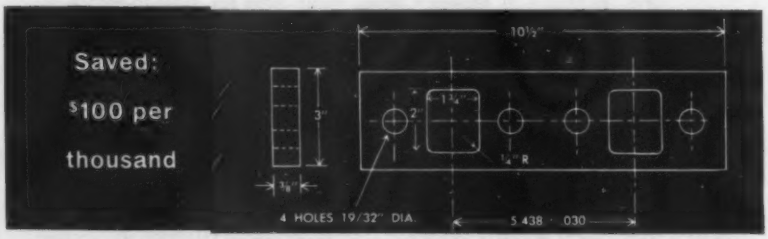
HIGH QUALITY: Ryerson recommended using flame-cut plates ranging in thickness from 1" to 8". Results: greater production flexibility, faster delivery, lower cost and a stronger product for this high-pressure service. Tight Ryerson quality control delivered plates of exceptionally clean surface to exact thickness of finished product, requiring little machining.

Look at these random examples and see how Ryerson Metalogics sparks real savings by continually searching for and suggesting new materials, methods and techniques.

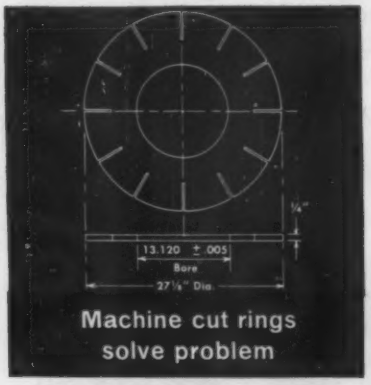
The broadest experience anywhere combines with the widest range of stocks available to offer you unbiased recommendations on the best material for any job—be it steel, aluminum or plastics. Always the right metal-fabricating machine, too—for Ryerson is the nation's largest distributor.

Your Ryerson representative is "Metalogics-trained" to help you *value-analyze* selection, fabrication and application problems. Get his constructive ideas soon, and see how he can help you select and apply material from our vast stocks. It's the "Metalogical" thing to do.

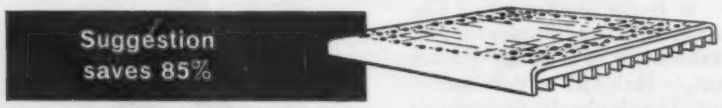
**The Ryerson science of giving optimum value for every purchasing dollar.*



PROBLEM: Muffler manufacturer required accurately finished mounting plates made from ⅜" x 3" bar. Cutting bars to size, burning 1¼" x 2" holes and drilling four 19/32" holes proved time-consuming and expensive.
SOLUTION: Ryerson recommended that they eliminate cutting, burning and drilling operations by stamping the part from Ryerson forming-quality plate. One operation instead of three cut costs $100.00 per thousand pieces and quickly justified the small initial investment in dies.



PLATES REQUESTED: Ryerson was asked to bid on supplying ¼" Type 410 stainless in 27⅛" square plates. Material was to be used for orifice plates for 16" burner, subjected to elevated temperatures.
RINGS RECOMMENDED: Going beyond material specs, the Ryerson representative found that the customer intended to cut plate into 27⅛"-diameter rings with 13.120" bore—and then mill 12 slots in outer diameter for expansion relief. Knowing the application, Ryerson recommended supplying machine-cut rings in which slots could then be punched rather than milled. Production savings enabled switching to Type 304 at less cost than Type 410 with slots milled.



ASKED FOR: Customer wanted 1" hot rolled plate to cover about 80' of 24" open trench. Plate was to be cut into 24" x 27" segments—each containing 900 ⅜" holes to filter the product.
RECOMMENDED: After studying application and cost, Ryerson recommended a design combining perforated light plate, formed to channel shape, and grating for structural support. Ryerson experience and imagination saved 85% of the original cost.

Soft touch on fabricating sheets

THE NEED: Cold rolled sheets that would take severe forming and retain smooth, dull surface for high lacquer finish. Sheet quality was found on inspection to vary widely from one shipment to the next, causing variations in forming and finishing operations . . . high reject rate.
THE ANSWER: The Ryerson representative showed how our stringent quality controls would assure consistent quality on every shipment so that forming and finishing could be standardized for better results . . . lower production cost figures.

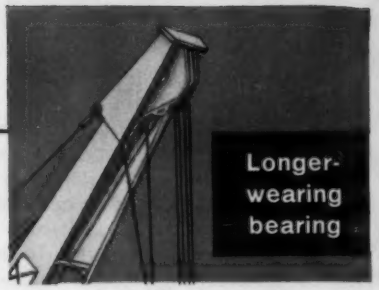
ACTION

BEFORE: Job shop was using MT 1015 tubing in the manufacture of this coupling. Machinability was satisfactory, but rising costs of operation led to a search for ways to economize.

AFTER: Careful study by the Ryerson representative brought about a change in material. He recommended using Ledloy® 170 tubing, which increased machining speed to 170 s.f.m. and stepped up production 30%. Ryerson's stocks include the widest range of fast machining alloys—types and sizes to fit your every need.

OLD WAY: A screw machine shop used nylon in the manufacture of nipple adapter and coupling nuts—until a Ryerson representative came on the scene.

NEW WAY: At his suggestion, they changed to Ryertex-Omicron PVC—cut costs 50%. PVC machined better—to closer tolerances, with improved finish . . . ran faster without "gumming." Note exact cutting of threads and barbs. Threads fit perfectly.



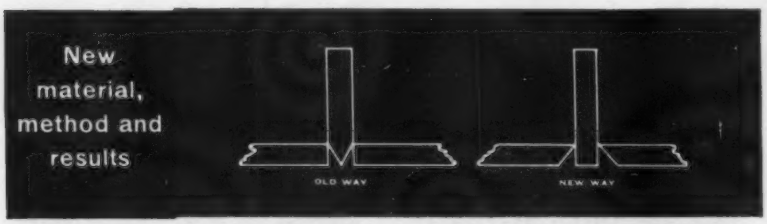
5-DAY LIFE: The sheaves that guide the enormous digging buckets of underwater dredges take a very severe load. Bronze bearing in the sheaves had to be replaced every four or five days.

5 MONTHS, SO FAR: After discussing the problem with a Ryerson man, the chief engineer decided to try a bearing made of Ryertex. The change was made, and five months later hardly any wear was noticeable! With its low friction coefficient, Ryertex is nonbinding, even on itself.

SEARCH: Complicated machining of a carbide grade gear shaft included cuts up to ½". It was discovered that required machining was too slow with the steel chosen for the job.
ANSWER: Rycut® 40 was recommended by the Ryerson representative. This free machining alloy fit the situation perfectly. The company found that Rycut 40 machined at 250 s.f.m., gave a better finish, increased tool life, and lowered total per-piece cost. An alloy in the Rycut series may well lower your costs.

2 metalworking machines for the price of 1

A fabricator of stainless steel kitchen equipment was recently in the market for a new squaring shear. The one under consideration had a gap-type frame which would enable him to do an important notching operation—necessary for certain sink tops. After careful study, a Ryerson machinery specialist recommended *two* pieces of equipment instead of one at no increase in total cost. The first, an underdriven shear. The second, a universal-type sheet metalworking machine that would do the required notching, plus many other jobs—adding versatility to the entire operation.



OLD: Rows of vertical aluminum grid members were attached to an aluminum base plate by notching the grid members and welding. (2024-T3 aluminum plate was used.) However, upon cooling, welds fractured—causing a high reject rate on this assembly.
NEW: A Ryerson representative suggested undercutting the base plate (as shown) instead of the grid members. This exposed a greater area to heat and permitted a larger deposit of weld material. Another Ryerson suggestion: change material to 5052-H34 aluminum, which responds better to welding operations.

PRODUCTS IN STOCK

STEEL—carbon, alloy, and stainless steel—bars, structurals, plates, sheets and strip, tubing, etc.

ALUMINUM—sheet (including new building sheet), plate, coils, rod and bar, tubing and pipe, building products, etc.

INDUSTRIAL PLASTICS—Ryertex-Omicron PVC in all forms. Also Ryertex® laminated phenolic plastics for bearings.

METALWORKING MACHINERY—the broadest line available from a single source for every kind of metal fabrication. Also specialized line of material handling equipment.

METALOGICS
RYERSON PUTS VALUE IN

STEEL • ALUMINUM • PLASTICS • METALWORKING MACHINERY

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Joseph T. Ryerson & Son, Inc., Member of the INLAND® Steel Family

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For more data circle this page number on card at back of book

equipped with an air-hydraulic head and table feed, as well as with standard slides.

Other Half Mills displayed were a vertical-spindle model for use as an independent machine or in combination with other units, and a single-column model with a speed reducer mounted behind the head for high-torque transmission applications.

Circle 601 on Readers' Service Card

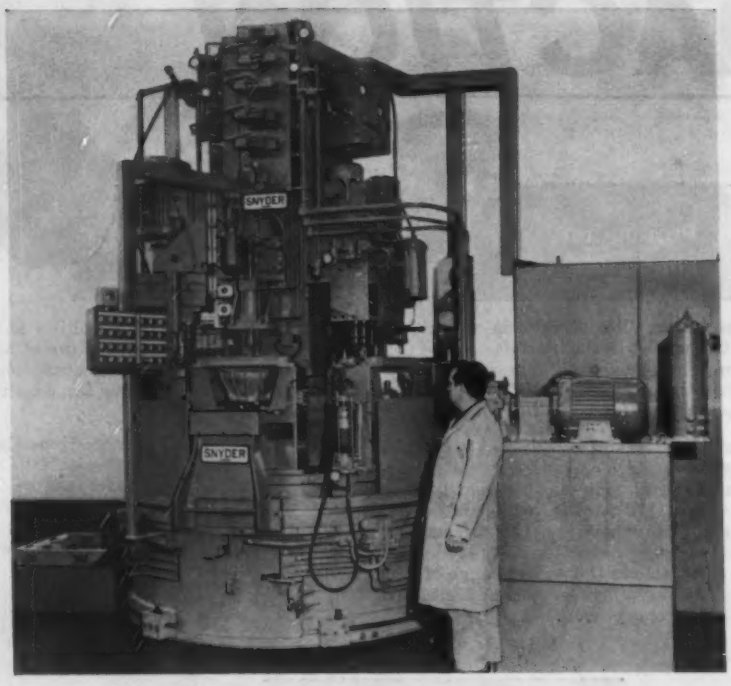
Special Unit-Constructed Center-Column Machine for Processing Flywheel Housings

A special five-station center-column machine tool, the first in a new line featuring standardized base and machining units, is announced by the Snyder Corporation, Detroit, Mich. This machine drills, reams, bores, and taps aluminum automotive engine flywheel cover housings at the rate of 163 pieces per hour at 100 per cent efficiency.

Circular T-slots at the top and bottom of the base permit wing-base units to be spaced around the column as desired. Conventional center-column machine bases have machined faces to which wing bases are keyed and bolted. This new base has been designed to provide for maximum flexibility in the future placement of units. Both slide and lead-screw tapping units that can be mounted on the column, as well as the heads that are mounted on these units, are standardized designs. They utilize standard drawings and unit assemblies. This arrangement serves to reduce designing time and avoid repeating pattern-drawing and pattern-making work.

The flywheel housings to be machined are loaded in the first station. Then they are processed through an automatic indexing and machining sequence around the column on the hydraulically operated, electrically controlled machine. Hydraulic power is supplied by a separate pump and tank unit.

At the second station a two-spindle boring head rough-bores and spot-faces holes in two locations, using inserted-carbide tools.



Snyder special machine featuring standardized base and machining units

The head is driven by a 12-hp motor and is mounted on a standard slide unit.

At the third station, a twelve-spindle drill head, powered by a 7 1/2-hp motor mounted on a standard slide unit, drills ten holes and drills and counterbores two holes. In the fourth station, an eleven-spindle head semifinish bores 2.50- and 3.25-inch diameter holes, drills two holes, drills and counterbores four holes, and reams four holes. This head is mounted on a standard slide unit and is powered by a 7 1/2-hp motor. At the fifth station, a Snyder standard tapping unit with a four-spindle head taps four 5/16-18 holes. This unit is powered by a 2-hp motor.

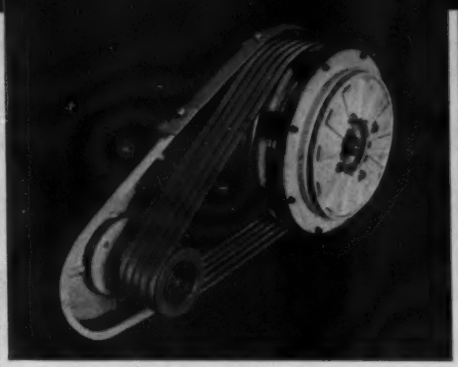
Circle 602 on Readers' Service Card

Cincinnati Induction-Heating Machine for Use in Fusing Ceramic Coating on Iron Pipe

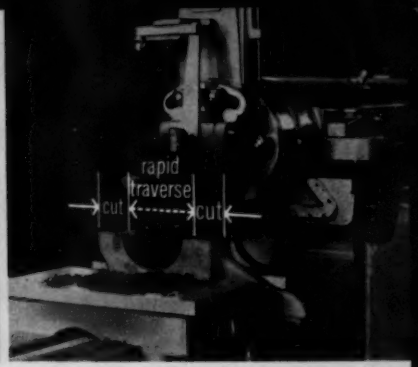
The Meta-Dynamics Division, Cincinnati Milling Machine Co., Cincinnati, Ohio, has announced an induction-heating machine designed and equipped for fusing a ceramic coating or frit on both the outside and inside surfaces of a pipe 1 1/4 inches in diameter by 18 inches long. This machine uses a new "building block" concept consisting of a portable monitor control panel mounted on a portable heating station. A scanning mechanism is used to spin-progress the part vertically through the heating coil of the heating station. Power is furnished by a motor-driven, vertical generator. The building block or modular design permits transfer of units from one production line to another. Compact design saves floor space.

The scanning unit includes limit switch control of heat and quench cycles and preset feed rates. Chromium-plated guide rods assure smooth operation and long life, eliminating corrosion from water. Infinitely variable feed rates are provided by the use of a direct-current electronic motor drive. The counterbalanced carriage reduces drag, resulting in improved speed regulation. Included

1. This 2" cut, .030" feed, proves the ability of the Cincinnati's 50 psi automatic lubrication to maintain oil films under the heaviest loads.

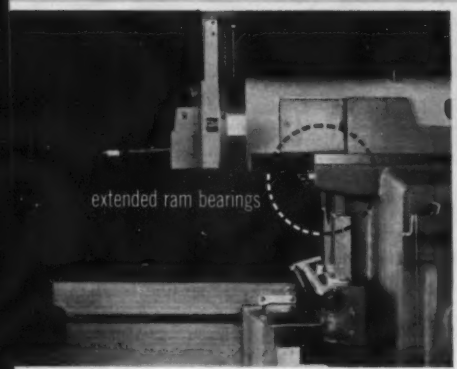


2. Brushless electromagnetic brake and clutch insure fast, easy operation of the ram without grab. They never need adjustment.

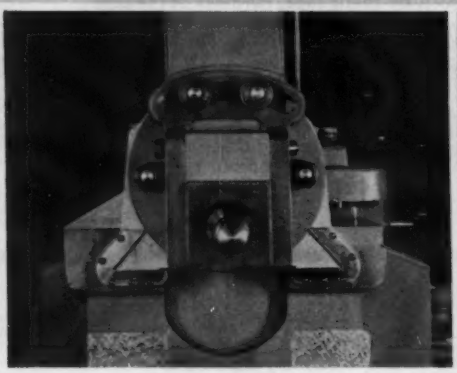


3. Both vertical and horizontal rapid traverse are standard Cincinnati features which profitably reduce time between each cut.

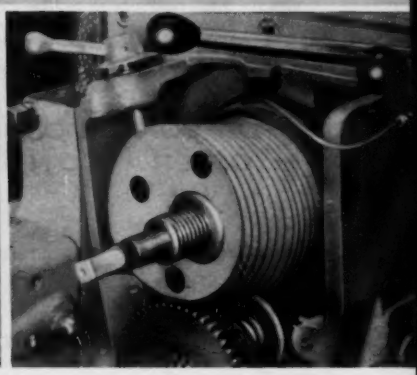
4. Extended ramway bearings increase ram support and minimize wear. Full table clearance to column provides the closest-coupled combination in the field.



5. Solid ramways, free of joints, hold the accuracy of Cincinnati shapers longer than others. Vee ways are cast integrally with the column for extra strength.

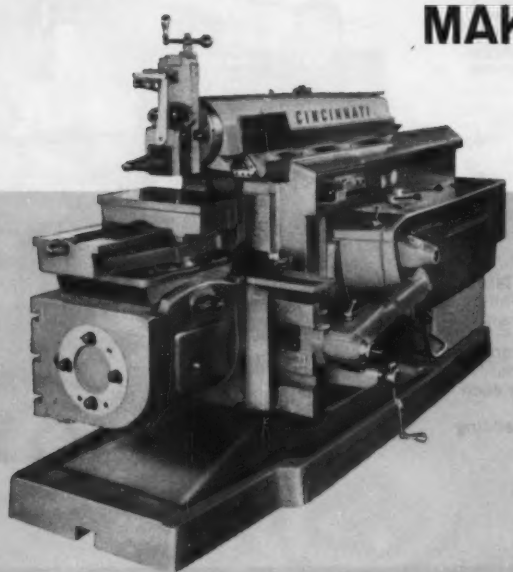


6. Individual cams for each feed, with follower always in contact give you a smooth (instead of a "bump") feed; results in superior finish on every job.



payoff features

MAKE CINCINNATI® SHAPERS YOUR BEST CHOICE



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THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.

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2 MICRO-PATH AUTOMATION SYSTEMS

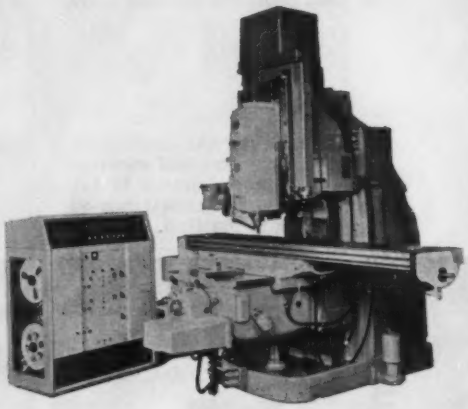
MPI 401

MAGNETIC TAPE CONTROL FOR CONTINUOUS PATH OPERATIONS

MICRO-PATH MODEL 401 offers utmost programming simplicity and installation economy to continuous path operations . . . can be installed on existing tools or designed into new equipment.

RECORD-PLAYBACK PROGRAMMING utilizes a special electronic stylus to trace a finished part or template. Programs can also be made direct from drawings utilizing drafting instruments. Pulses actuating the table in its desired path are simultaneously recorded on magnetic tape. Playback of the tape duplicates the path and the part automatically. Computer techniques are bypassed.

3 AXIS OPERATION—Model 401 operates in any 2 out of 3 axes simultaneously, permits production of mold cavities and other contouring as well as simple profiling.



MPI 801

PUNCHED TAPE POSITIONER FOR POINT-TO-POINT PROGRAMS

THE NEW MICRO-PATH 801 POSITIONER is a revolutionary advance in point-to-point programming, with design flexibility that guards your investment against obsolescence!

PUNCHED TAPE PROGRAMS—Easy preparation of your own programs in your own plant with standard Flexowriters or other BCD units.

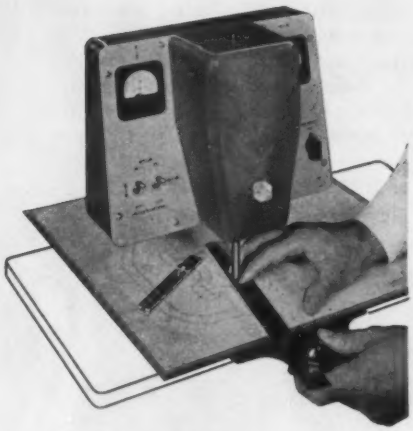
COMPLETELY TRANSISTORIZED—Transistors perform all switching functions and logic, insuring virtual freedom from maintenance . . . no vacuum tubes, no mechanical relays, no oxidizing contacts, no mechanical motion and resulting wear.

HIGH LOCATING SPEED—Fastest system yet! Utilizes full traverse rates from point to point. As location is reached gage pulses count overtravel. Error signal between pulse voltage and program drives servo, returning table to location at a rate proportional to overtravel.

DIRECT DECIMAL READ-OUT—Table position is decimally indicated at all times on meters contained in console panel.

MANUAL INPUT—Single parts can be produced without taped programs by setting up manual controls for each position. Parts produced by tape programs can also be amended, adding new hole positions or permitting individual deviations.

WITH EASY PROGRAMMING IN YOUR OWN PLANT



FAITHFUL REPRODUCTION—A closed loop system keeps the machine "on program" with part-to-part accuracy of .001". Electronic repeatability is to .00025".

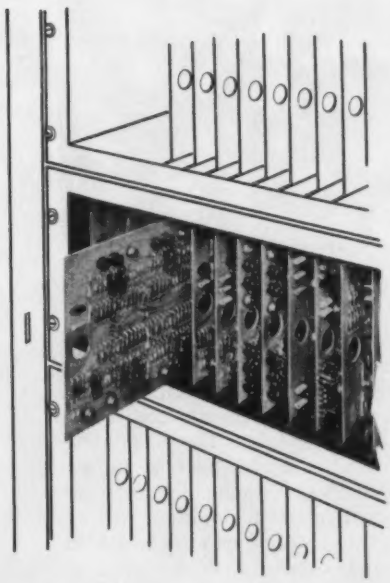
ELECTRONIC SCALE FACTOR—Enables programming from a print 4 times larger than the part . . . reduces errors, allows more operator reflex time for programming.

ELECTRONIC BACKLASH CONTROL—One program can be used interchangeably on several machines even though lead screw wear differs in each. Compensation is made at the console of the machine in use without altering the tape.

LOW COST—As little as 1/5th the cost of other systems producing similar results!

WHERE MICRO-PATH MAKES BIG SAVINGS—Chip production time greatly increased. Faster traverse rates between cuts with no risk of work spoilage. 100% tool loading at highest practical cutting speed. Elimination of multiple setups, drill jigs, rotary tables and other special positioning equipment. Avoids operator errors. Insures consistent accuracy, part-to-part.

GET ALL THE FACTS ON MICRO-PATH! Before installing any automation system, consult with Micro-Path! Prompt recommendations will be forwarded by our engineering department. Please include operating requirements in inquiry.



MODULE DESIGN INSURES EASY MAINTENANCE—Each 801 contains 37 individual plug-in printed circuit components. Built-in glow lamps indicate correct functioning or instantly spot a faulty board for quick factory exchange or local repair. 13 "spare" modules satisfy all requirements of the 37 boards.

FLOATING "ZERO"—The starting reference point, or "zero," can be located anywhere on the table or workpiece and can be subsequently relocated, if desired. All subsequent measurements accurately accrue from the new location.

"MIRROR" IMAGES can be produced from the same tape with axis reverse switches.

CONTINUOUS PATH CONVERSION—With the addition of director modules and access to computers and programming techniques, the 801 can be expanded to a combination "POSITIONING-CONTINUOUS PATH" system.

MODEL 850 2-AXIS POSITIONING TABLE—Ideal for high precision point-to-point and continuous path applications. The table glides on pre-loaded rollers running on hardened steel ways and is driven by hydraulic rotary motors attached to ball lead screws. The motors are controlled by hydraulic servo valves responding to the electronic commands. Static friction and backlash are so low that a .0001" command results in a .0001" motion, starting from a stationary position! Both axes are capable of simultaneous motion.

SPECIFICATIONS: Absolute linearity: ±.0002"/ft. at 70°F. Repeatability: ±.0001". Positioning Speed: 50" min. @. 0001" least count; 200" min. @ .001" least count.

MICRO-PATH INC

A SUBSIDIARY OF UNITED INDUSTRIAL CORPORATION

10321 ANZA AVENUE, LOS ANGELES 45, CALIFORNIA

are multi-circuit timers for accurate control of spot heating applications and replaceable stainless-steel centers that permit fast change-over for a wider and more interesting variety of work.

The portable monitor control panel consists of two units, the control section and the power section. This design permits back-to-back mounting or side-by-side arrangement for wall mounting. The portable heating station is available in 7 1/2- to 30-kw capacity with a high-frequency line contactor station or a 50-kw capacity without a high-frequency line contactor. This unit can also be easily mounted on special tooling or interlocked with other stations.

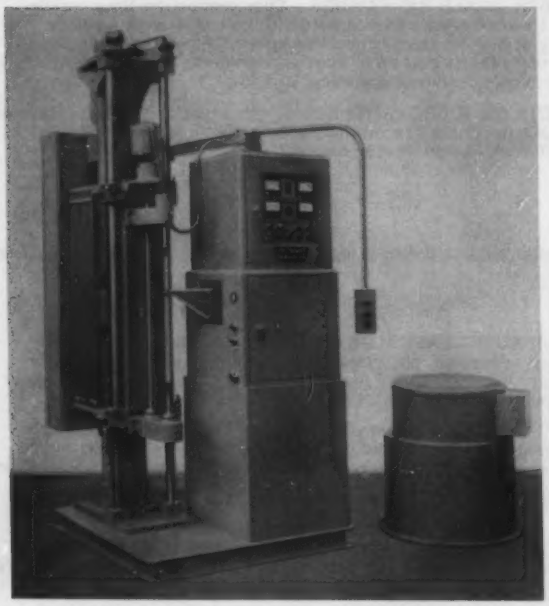
Circle 603 on Readers' Service Card

Automatic Machine for Joining Sections of Stainless-Steel Honeycomb Core

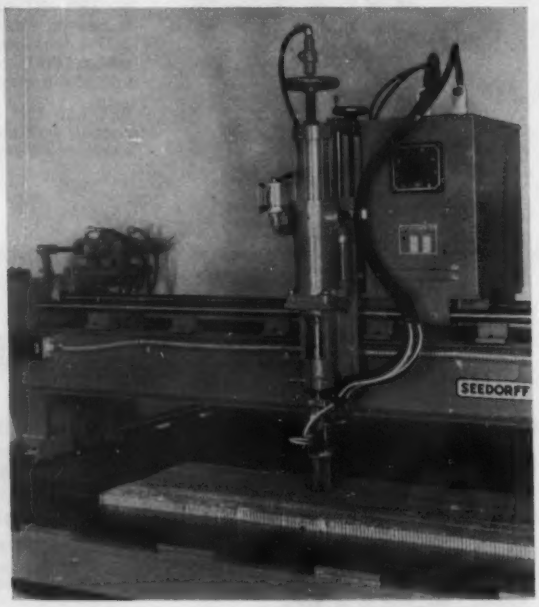
A newly developed automatic machine for joining stainless-steel honeycomb core sections by automatic spot and seam welding has been announced by A. P. Seedorff & Co., Inc., Bell, Calif. The machine is equipped with a 9- by 18-foot work-table complete with cross gantry, on which are mounted a traveling welding head, 10-kva transformer, electronic synchronous welding controls, and pneumatic adjustable automatic indexing unit.

The illustration shows a detail of the adjustable welding head on the indexing carriage. Two narrow copper-alloy electrodes are shown at the bottom of the head surrounded by eight cell-shaped probing fingers which automatically position the electrodes and line up the core sections. The welding head is actuated by an "Airdraulic" cylinder for smooth uniform performance and is fully adjustable for splicing cores ranging from 1/4 inch to 3 inches in depth. The fully automatic indexing mechanism which moves the electrodes from one cell to the next operates through a lead-screw with anti-friction ball bushing bearings. Both electrodes and indexing mechanism are adjustable for various sizes of core cells.

Circle 604 on Readers' Service Card



Cincinnati induction-heating machine and equipment for fusing ceramic coating to pipe

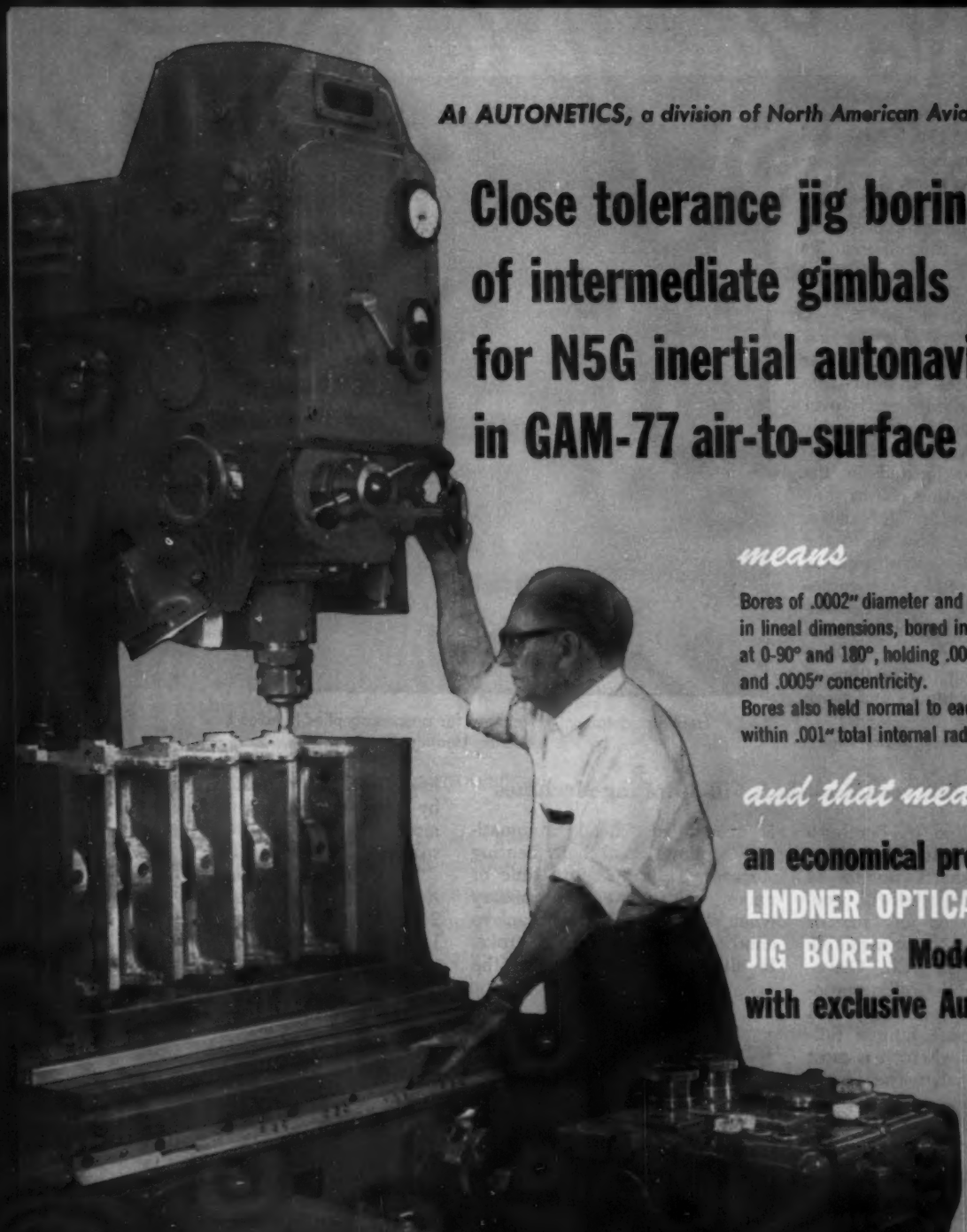


Seedorff automatic spot- and seam-welding machine for joining honeycomb sections

Machine Equipped with Induction-Heating Unit and Work-Holding Blocks for Processing Plier Handles

A production rate of 2640 units per hour is attained in processing the smallest of nine sizes of pliers formed and trimmed on a Ther-Monic machine produced by the Induction Heating Corporation, Brooklyn, N. Y. This equipment was developed for one of the largest manufacturers of pliers who decided to heat the plier handle blanks, rather than form and trim them cold, in order to improve the metallurgical quality and finish of their product. The heating unit was required to raise the temperature of the work-pieces to 1300 degrees.

A semiautomatic conveyor and two-turn conveyor type work-heating coil are used in the machine. The work-pieces are hung on pins at the right side of the conveyor and move toward the left through the work coil. As they leave the coil, the parts are stripped off the pins by the wiping action of an adjustable cam located just beneath the work-holding blocks. These holding blocks were designed to be set up with the single pin down, as shown in the illustration, so that the larger plier handles are held 2 inches apart and processed at the rate of 800 an hour. The block may be reversed by simply loosening the center screw, rotating the block 180 degrees, and re-tightening the screw. The double-



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Close tolerance jig boring of intermediate gimbals for N5G inertial autonavigators in GAM-77 air-to-surface missiles...

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Bores of .0002" diameter and within .0005" in lineal dimensions, bored in three locations at 0-90° and 180°, holding .0005" parallel and .0005" concentricity.
Bores also held normal to each other within .001" total internal radius.

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pin end, now at the bottom end of the block, holds the plier handles on 1-inch centers.

The conveyor is powered from a variable speed type sprocket-and-chain coupled transmission. To keep the variable-speed drive cost to a minimum, different sprocket gear ratios are employed: a 6-inch diameter sprocket for smaller handles and a 12-inch diameter for the larger ones. An adjustable guide rail, mounted directly over the work coil, and another guide rail, for the conveyor blocks, keep the work-pieces located in the center of the heating coil as they are carried through the latter unit. To prevent damage to the drive and conveyor, a slip clutch with reset torque is also incorporated in the machine. The installation was planned to handle a total of twenty-eight types of plier handles by changing the position of the part-holding blocks and work heating coil.

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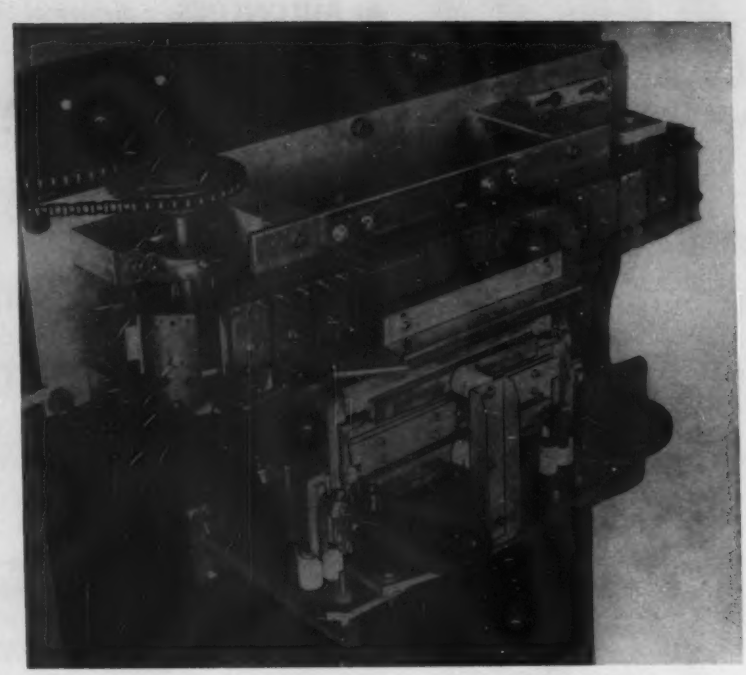


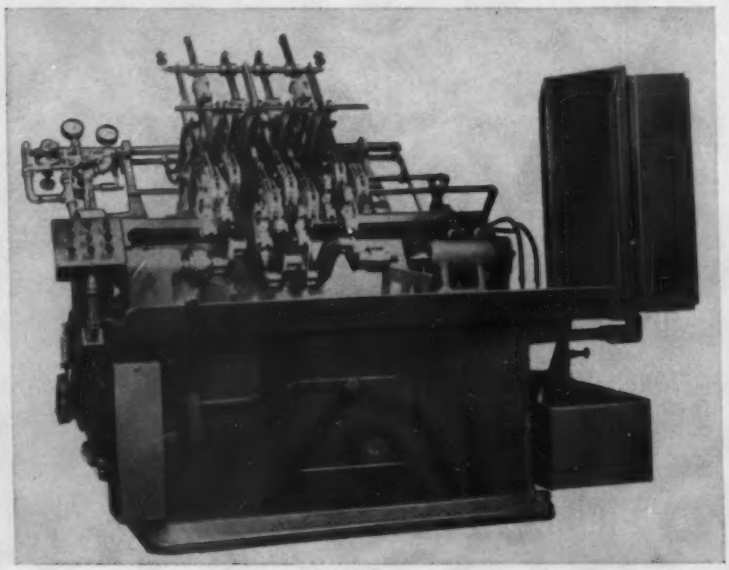
Heating equipment developed for processing plier handles built by the Induction Heating Corporation

Footburt-Schraner Crankshaft Fillet-Rolling Machines

A complete line of Footburt-Schraner crankshaft fillet-rolling machines for shafts up to 84 inches long, with models for processing all fillets on any size or style crankshaft, is now available from the Foote-Burt Co., Cleveland, Ohio. The fillet-rolling process is said to economically and efficiently eliminate fatigue failure at the fillets where it is most likely to occur when the crankshaft is subject to high torque. The fillet-rolling machines have specially designed, hardened rollers (two opposed sets in each head). The contact surfaces on the roller face oscillate back and forth across the fillet as they turn under pressure against the rotating crankshaft. These rotating rollers create compressive stresses on the skin of the metal, superimposed over tensile stresses formed in the fibers underneath. The resulting balance of controlled stresses strengthens the fillets against fatigue failure.

Designed for high production, these machines turn out up to forty-five pieces per hour. A unique feature of the fillet-rolling machines is that no master crank is needed; the heads automatically follow crankshaft bearing surfaces. Thus no setup time or major adjustment is necessary when changing from one crank to another with a different stroke. If fillet spacing changes, the heads can be relocated quickly by loosening one screw on each, moving the heads to the new spacing, and retightening.

The Footburt-Schraner Model A rolls fillets on crankshafts up to 24 inches long with swings up to 12 inches; Model B accepts work up to 40 inches long with swings



Crankshaft fillet-rolling machine announced by the Foote-Burt Co.

let's talk CAPACITY

CAPACITY, what does this represent in terms of dollars to a prospective buyer of metal cutting machines.

We at **MICHIGAN** feel that manufacturing **CAPACITY** is an important asset and most beneficial time saving aid available. We constantly strive to improve our manufacturing and assembly methods, this in turn increases our **CAPACITY.** The ability to manufacture machines in less time, results in a low product cost to the customer.

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- Complete engineering.
- National sales staff.
- Blueprint and duplicating departments.
- Manufacturing facilities to machine every detail in all of our many components.
- **MICHIGAN** designs and fabricates electrical, hydraulic and lubrication installations.

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MICHIGAN'S CAPACITY pays off in savings to our customers. If you're looking for a special metal cutting machine of any kind, remember **MICHIGAN**—we specialize in dependable delivery, low product cost and excellent service. Send us your inquiries, we will be pleased to serve you promptly.

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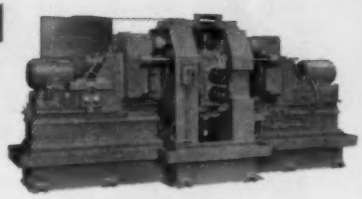
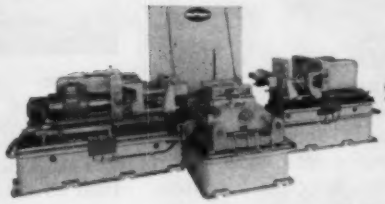
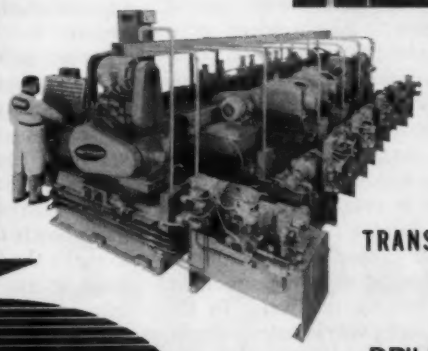




SHUTTLE

SPECIAL



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up to 12 inches; Model HD holds crankshafts up to 84 inches long with swings up to 16 inches. All can be provided with varying numbers of heads. Clamps, tailstock, and rolling arms (for both raise-lower and clamp-unclamp) are hydraulically operated.

Circle 606 on Readers' Service Card

Machine for Welding Coated Metal

For almost a year, a manufacturer of painted-metal novelties has been welding coated steel strip without marking the paint. The coated-metal welder used for this work was built by Precision Welder & Flexopress Corporation, Cincinnati, Ohio. It is referred to as a first cousin to Precision's vinyl welder, but is designed to handle a wider range of materials, including steel coated on one side with either paint, acrylic lacquer, or wood veneer.

The welder is used to attach brackets, hinges, braces, and other parts to the back (uncoated) side of preformed, decorative steels that are coming into wide use in the appliance, luggage, furniture, business machine, and automotive industries. Vinyl-coated steel, the first of such materials to attain prominence, has been successfully welded on the new equipment. Many other organic surfaces now being applied to steel strip by mills, converters and similar means can also be welded.

Magnetic-force projection welding is a permanent fusion method for fastening these materials. In magnetic-force welding, the same current surge which brings the parts to welding heat is used to energize a magnet. The magnet drives a forging hammer down on the weld projection, upsetting it at the instant of maximum heat, and so forging the weld. In the welding of vinyl-coated steels, and steels coated with other materials, the shape of the weld projection is important. The proper shape and size of projections on other new materials required to create strong welds that are invisible on the coated side are being determined by constant research and experimental work.

Coated-metal welder built by Precision Welder & Flexopress Corporation

This kind of welding is practical on stock as thin as 0.015 inch, including the coating. The size of the weld nugget is limited by the thickness of the material, but weld strength equals AWS standards on vinyl-coated steel of 20 gage. Generally, a matte-finish coating is to be preferred for welding, although a glossy coating can be used successfully on all but the thinnest gage materials.

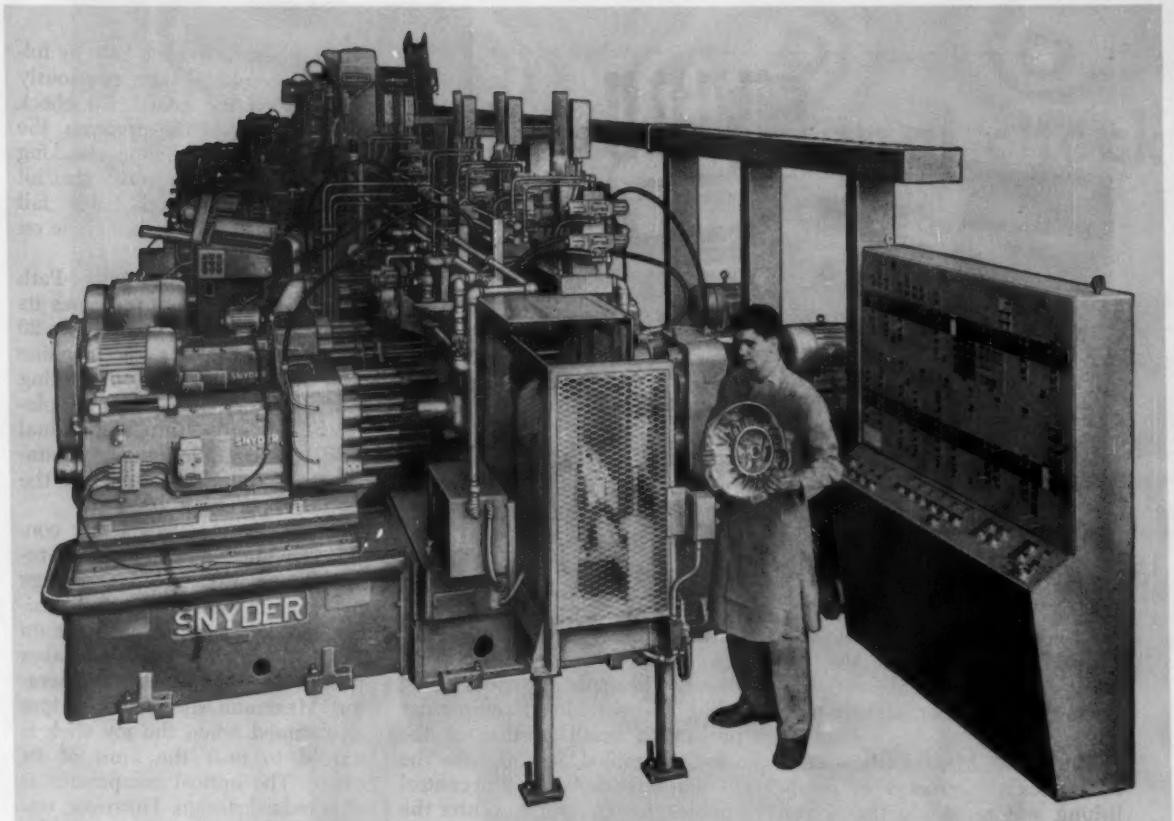
An important recent result of this company's research work is a new gun type magnetic-force welding head. The head is cylindrical in shape, and of such small diameter that numbers of these heads can be closely spaced to make the kind of multiple-head welding machine favored by the automobile industry. Such machines may make a hundred welds at a time. The company has also developed an experimental welding machine for manufacturers interested in doing developmental welding with coated materials. One machine is now at work in the Ford laboratories, and others are in use abroad.

Circle 607 on Readers' Service Card

Micro-Path Automatic Circuit-Board Drilling Machine

Micro-Path Inc., Los Angeles, Calif., is introducing to the electronics and electrical industries an automatic high-speed circuit-board drilling machine that is designed to increase hole-positioning accuracy to one-thousandth of an inch, practically eliminate human error, and save a substantial number of man-hours in programming. Coupled with Micro-Path's magnetic tape control, this new MPI 440 automatic circuit-board drilling machine is capable of drilling 40 holes per minute with each drill head; 640 holes per minute with four stacks of four boards each, with an average positioning time amounting to less than one second.

One of the most unusual features of the machine is its optical programmer. Essentially a comparator equipped with a large viewing screen, the programmer is simple to operate, making it possible for a speed-up in program-



DIFFERENT SIZED PARTS INTERMIXED AT RANDOM ARE PROCESSED AUTOMATICALLY ON SNYDER SPECIAL 56-STATION TRANSFER

Here's another big Snyder special "building-block" transfer with a bit of extra versatility.

Specifications called for one sequence of operations on a big aluminum transmission cover case for domestic use and a different sequence on a smaller cover for export.

Schedules set a production rate of about four domestic units to one export unit but, for production convenience, the machine had to accept these parts intermixed at random and run them through automatically.

So, Snyder Engineering designed a "collar" which bolts to the smaller piece, bringing it up to locating and clamping dimensions of the larger piece. Lugs on the collar and workpiece control appropriate switches which by-pass certain operations. Parts are automatically positioned in process.

Operations include drilling, reaming, boring, tapping, chamfering, spotfacing, center holing, end milling, probing, air gaging, pressing in rectangular plug, pressing in bushing and a couple of washing operations.

Production is 150 parts an hour at 100% efficiency. Any of the 20 segments can easily be converted for comparable operations on other parts and the number of segments can be increased or reduced at any time. Your inquiries are invited.

SNYDER
CORPORATION
(Formerly Snyder Tool & Engineering Company)

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123

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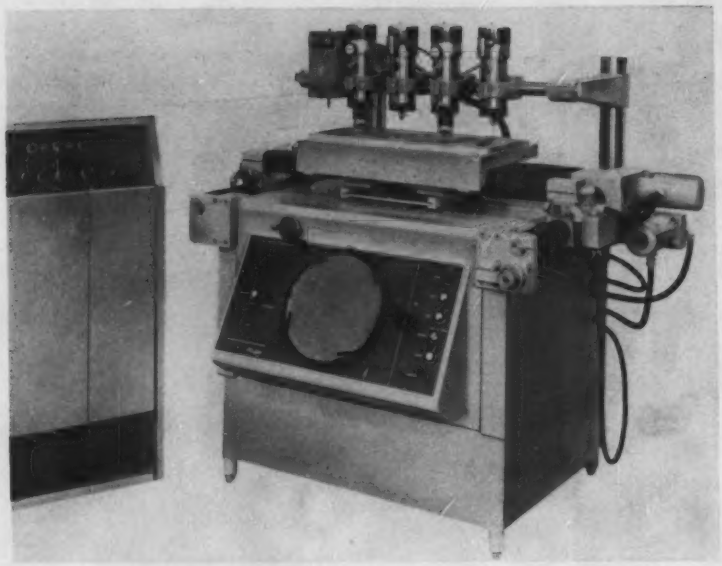

Automatic circuit-board drilling machine announced by Micro-Path Inc.

ming as well as significantly reducing the number of hole-positioning errors.

The new Micro-Path system eliminates the process of establishing and recording the X and Y coordinates of each hole to be drilled. To program the MPI 440, the operator inserts either an etched master board, or the negative to be used for contact printing, into a viewing slide located directly beneath the positioning table. A conventional comparator projects a small portion of the view, magnified 20 times on the 14-inch screen. A joy-stick control enables the operator to center the image of the individual holes within a tolerance circle superimposed on the screen. As soon as a hole is centered, the operator enters a "drill down" command on the recording tape. The operator then proceeds to each hole by following a colored path previously marked on the board. To check the accuracy of the program, the operator reruns the tape, checking the programmer to verify that all of the programmed holes fall well within the tolerance circle on the viewing screen.

Playback for the Micro-Path drilling machine is four times its programming rate. On a table 20 by 30 inches in size, the machine also has the capability of routing contours or dividing multiple-circuit boards into individual boards. A contour stylus programmer arrangement is used for the routing operations.

The joy stick is a velocity control having an exponential response so that relatively large movements from its vertical position produce slow movements on the drill table. This design makes precise control easy for the operator. Maximum speed of 100 ipm is obtained when the joy stick is moved to near the limit of its range. The optical comparator is of standard design. However, unlike conventional comparators, the image is focused on the screen by moving the lens back and forth, rather than by making adjustments of the part or viewing slide.

Circle 608 on Readers' Service Card

Heat-Treating Furnace

Hevi-Duty Electric Co., Milwaukee, Wis., displayed its improved Clean-Line furnace at the Chicago Show. This gas-fired unit fits into production-line operations where continuous heat-treating is required. It can be used for bright hardening, carburizing, carbonitriding, and annealing.

The equipment operates completely automatically from loading to quenching: A pusher-arm on the loading table directs work baskets into the heating chamber. With cycle timers and controls set, the load is brought up to operating temperature, maintained for a prescribed interval, then moved into the quenching chamber. There, it is submerged in recirculating oil, then raised to drain.

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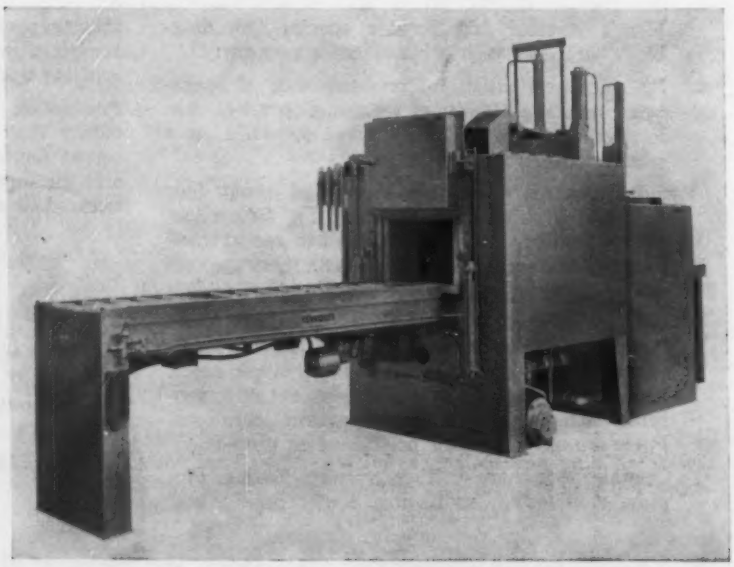
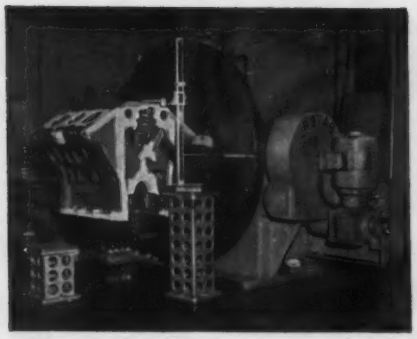


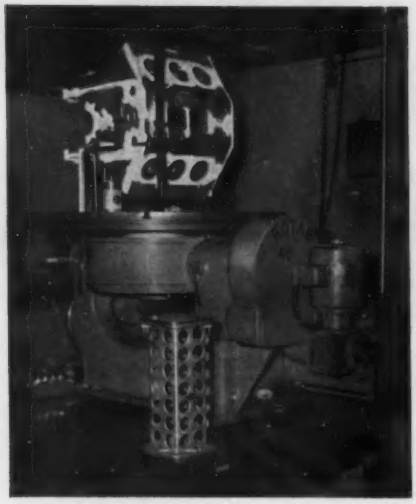
Automatic furnace brought out by Hevi-Duty Electric Co.



Dimensional check on 7 planes in one set-up!

up to 50% savings in time and manpower

Faceplates from 12" to 84" in diameter



Yes . . . every angle, diameter, straight line, every critical surface, on seven different planes of a V-type block, completely accurately checked without disturbing the initial set-up! How is it possible? With Machine Products' ROTAB universal rotary positioning table, that's how.

And consider the advantages. Previously, this same operation required two men, who had to "wrestle" the block into seven separate set-ups . . . each time re-establishing the locating point. With ROTAB the V-block is loaded on the horizontally positioned table, locating point determined, block clamped in place. Then, ROTAB's precision, movable graduated ring is set at zero to start the angular or radial check, and one man, using motor-powered, push button tilting and rotation runs the entire inspection, saving up to 50% in time, increasing accuracy, reducing rejects.

This, briefly, is what ROTAB has accomplished for one of the nation's leading diesel engine manufacturers.

ROTAB, with its unlimited applications, can do wonders for you, too.

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Federal Travel-Head Seam Welder

A special travel-head seam welder with forming clamps has been developed by the Federal Machine & Welder Co., Warren, Ohio, for seam welding the overlap flange in panel vent air outlets for automobiles. This machine transfers the blank from the load position into the forming unit, where it is formed into a shell and the side seam is welded. After the weld is made, the forming clamps release and the transfer mechanism ejects the welded part from the machine.

The seam is approximately 5 inches long. Weld pressure is approximately 1200 pounds at 60 psi; speeds are adjustable from 200 to 400 ipm. A 200-kva welding transformer supplies the welding power. Production is at a rate of over 500 parts per hour.

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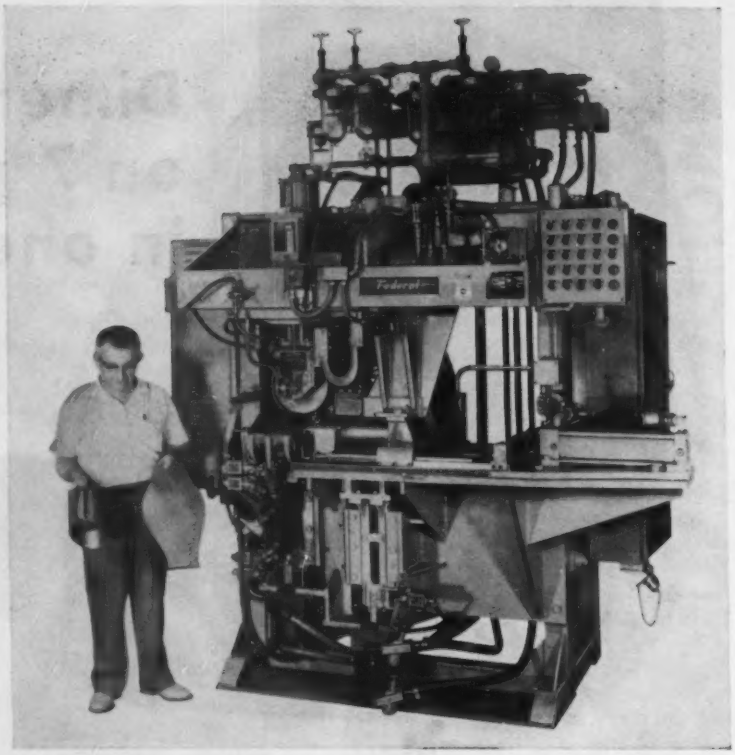


Seam welder for automobile part made by Federal Machine & Welder Co.

"Flying Scot" Planer with Hydraulic Feed

A small open-side planer, called the "Flying Scot," recently introduced by the G. A. Gray Co., Cincinnati, Ohio, features a unique control station which facilitates the rapid positioning of saddles, slides, or rail. The hydraulic control station, located on the end of the rail, is designed to permit an infinite saddle feed from 0 to 1/2 inch. After the appropriate levers have been engaged at the control station, the forward and reverse buttons on the pendant station can be used for positioning.

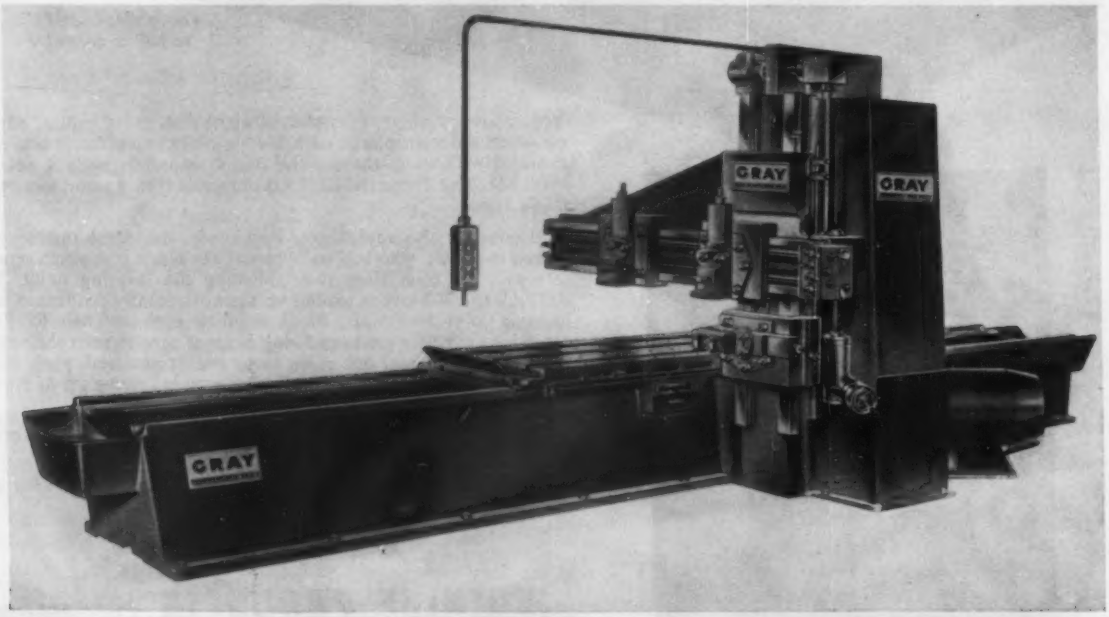


Fig. 1. Gray Flying Scot low-priced planer designed for fast planing with carbide tools

SPIROPOINT*

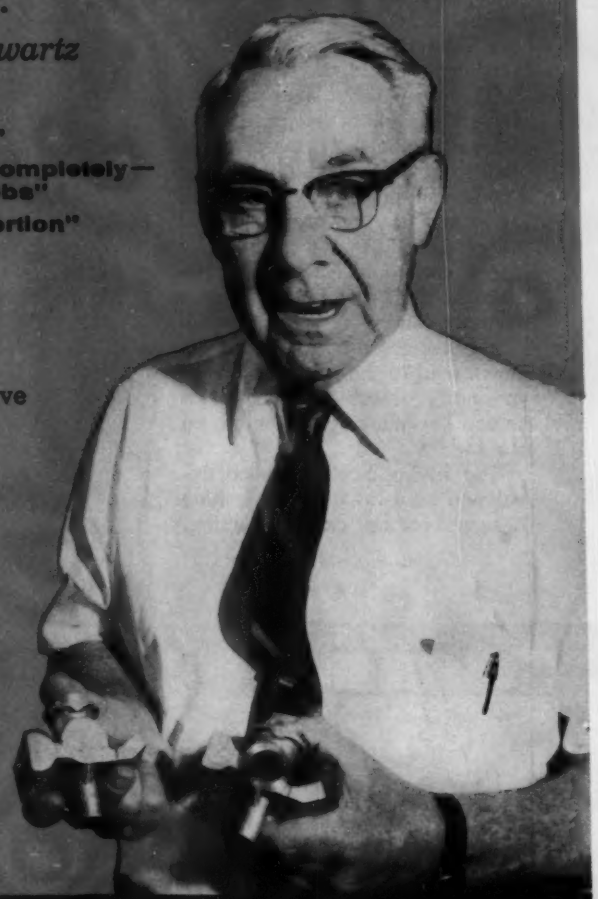
makes twist drills produce at Breeze Corporations, Inc.

says Works Manager Harold Schwartz

"...50% greater drill life"
"...up to 40% saving in drilling time"
"...centering operations eliminated completely—reaming unnecessary on many jobs"
"...70% reduction in workpiece distortion"

Breeze Corporations, Inc. of Union, New Jersey, executes complete design and production of precision electrical, electro-mechanical, and hydro-mechanical components and systems. Drilling costs have been cut at Breeze because, with spiral points, all holes are "right on center, round, smooth, and right to size—*at both ends!*", Mr. Schwartz stated.

* Cincinnati SPIROPOINT® Drill Sharpener applies the new spiral point geometry to standard twist drills in a matter of seconds.



Works Manager Schwartz holds "Guillotine" safety device used on helicopter hoists. Production drilled holes 1½" deep are held to .001" tolerance on straightness.

Aluminum slip ring housing 3' in diameter has 576 holes. The ¾" holes are drilled through ¾" metal with spiral point drills in one-third the time normally required. Change in shape of the relatively fragile casting was negligible.

¾" drilling of this missile control launcher part is held to .001" tolerances on hole location and diameter—center drilling and reaming operations eliminated.

CINCINNATI LATHE AND TOOL CO.
Cincinnati 9, Ohio
HYDRASHIFT Lathes • CINCINNATI Drilling Machines • SPIROPOINT Drill Sharpeners

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Dials which control the saddles, slides, and rail are calibrated in thousandths of an inch. They can be set manually by means of a safety crank when the machine is not running. The safety crank, shown in the upper right section of the control area (Fig. 2), automatically disengages itself when feeding or rapid traversing.

The arrow-faced dials are used for adjustments in positioning when the machine is in operation. Rail screw and rail elevating screw run on ball bearings. All gears and bearings are encased in an oil- and dust-tight case. The speed and rapid traverse mechanism of the slides is driven by a common shaft in the cross-rail. The bevel gears that transmit the down feed to the slide are always in mesh, selectivity being obtained by engaging the clutch on the saddle.

The Flying Scot has been developed as a low-priced machine designed for fast carbide planing.

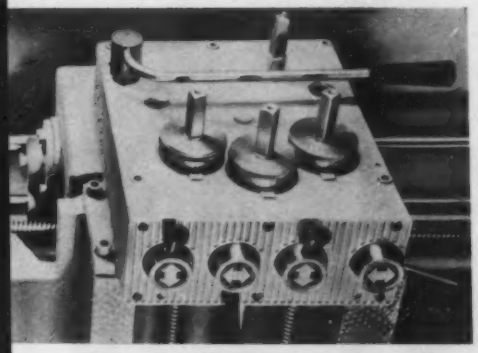

Fig. 2. Hydraulic control station of planer, Fig. 1, which provides means for rapid positioning

It cuts both ways and is intended for normal machine shop use, or for use in practically any industry where a small planer is needed. The machine is available in nine combinations of table widths and heights. Basic sizes are 30, 36, and 42 inches. Power is supplied by a 60/75-hp variable voltage drive. The planer ratio is 6 to 1, and the motor is adjusted in the cut and return direction from 180 to 1800 rpm as required.

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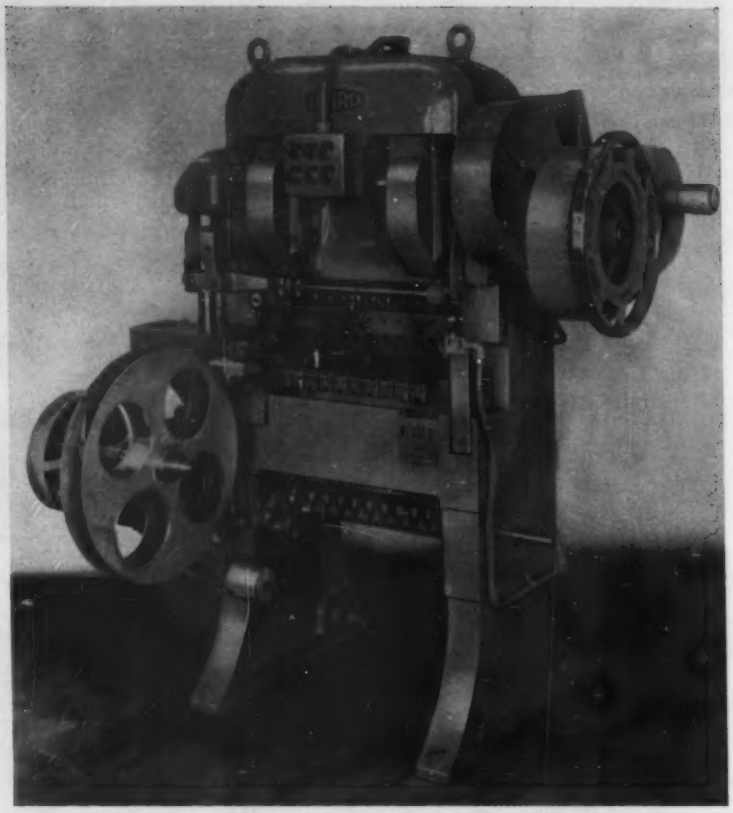


Baird Model 3-25 transfer press equipped with quick-acting electric clutch seen on upper right below flywheel

Baird High-Speed Transfer Presses Equipped with Quick-Acting Brake

An electric clutch brake is now available on the transfer press Models 2-19 and 3-25 built by the Baird Machine Co., Stratford, Conn. These high-speed transfer presses produce stamped and drawn parts from roll stock. The clutch brake stops the machine in one-half revolution, preventing severe and costly damage to tooling and parts.

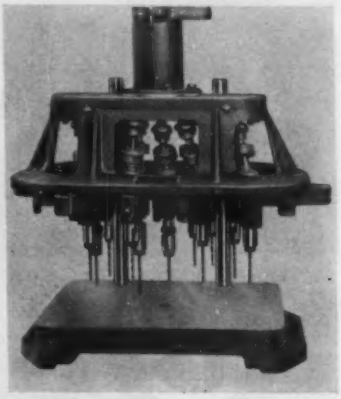
With a conventional mechanical clutch brake, two revolutions occur before complete stoppage. During this time, serious tool damage can result. The new clutch can easily be incorporated in systems designed for the application of electronic gaging and inspection of parts during production runs. It also allows a single operator to run several machines simultaneously.

Circle 612 on Readers' Service Card

Multiple-Spindle Drilling and Tapping Head

The Ettco Tool & Machine Co., Inc., Brooklyn, N. Y., has added a Model 1100 Knuckle-Head to its line of universal ball-joint adjustable-spindle drilling and tapping heads. The new head can be

(Continued on page 224)



Ettco Knuckle-Head drilling and tapping head

ever hear of the Cleco

"quality control package"?

"Quality Control Package" is the term we use to describe our method of designing, manufacturing, and servicing air tools. Too, we think this term best describes what Cleco offers you. Outstanding tools, engineering assistance, and service directed towards helping you increase the quality of your products with greater speed and economy.

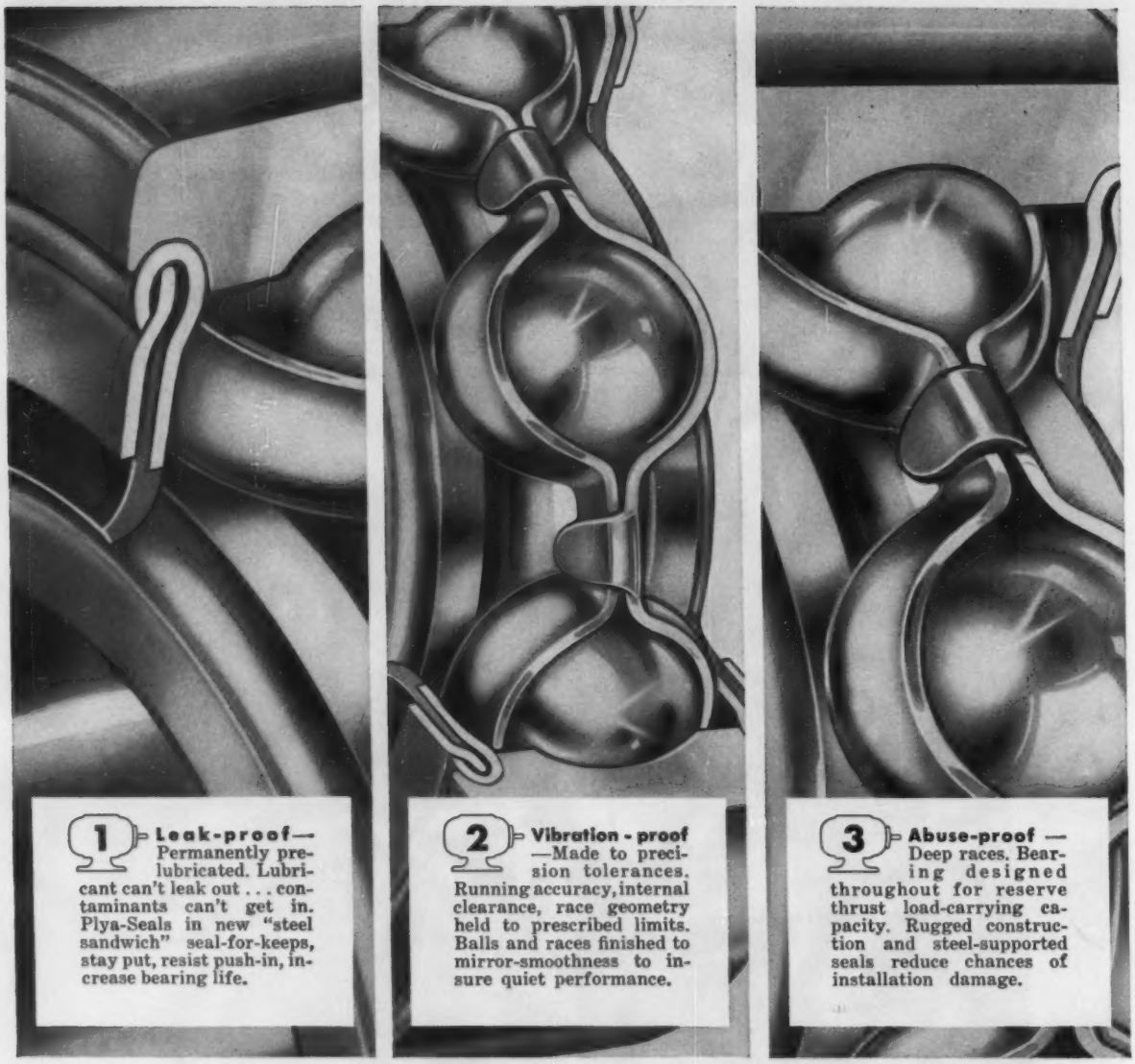
Built-in quality is a vital part of the Cleco "Quality Control Package." Cleco air tool designs are never finalized until their value has been proved on customer operations. In the production phase, our roving specialists perform 100% surprise inspections at all critical points. Each and every completed tool is tested in a sound-proof room . . . checked against engineering specifications for power, air consumption, and speed. Appearance, too. **From Cleco® you get quality all the way.**

CLECO
AIR TOOLS

"quality tools engineered for industrial progress"

A Division of REED ROLLER BIT COMPANY • P. O. BOX 2119 • HOUSTON 1, TEXAS, U.S.A.

IN CANADA: Cleco Pneumatic Tool Company of Canada, Ltd., 927 Millwood Road, Leaside (Toronto), Ontario



1 **Leak-proof**—Permanently pre-lubricated. Lubricant can't leak out . . . contaminants can't get in. Plya-Seals in new "steel sandwich" seal-for-keeps, stay put, resist push-in, increase bearing life.

2 **Vibration-proof**—Made to precision tolerances. Running accuracy, internal clearance, race geometry held to prescribed limits. Balls and races finished to mirror-smoothness to insure quiet performance.

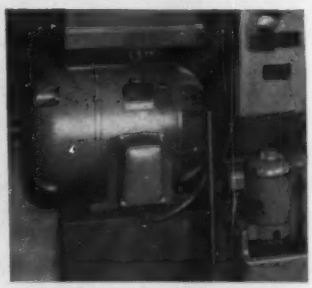
3 **Abuse-proof**—Deep races. Bearing designed throughout for reserve thrust load-carrying capacity. Rugged construction and steel-supported seals reduce chances of installation damage.

Fafnir gives you the seal . . . the "smoothness" . . . the stamina you need in ball bearings for electric motors!

Notice the seals in this Fafnir ball bearing. They're "rolled in". These newly designed Plya-Seals won't work loose because they are gripped between two steel supports . . . nor will they push in. They provide positive protection against contaminants and loss of lubricant.

You also get whisper-quiet performance. Balls and races in Fafnir precision ball bearings for electric motors are micro-finished to mirror-smoothness. No noise . . . no vibration. Extra-deep race design adds thrust capacity and minimizes mounting damage.

Look to Fafnir for *your* electric motor ball bearings. You'll find all sizes and types (open, shielded, or with contact, slinger, or felt type seals) . . . plus the capacity and uniformly high quality to meet your needs precisely. The Fafnir Bearing Company, New Britain, Conn.



Over 5000 electric motors in Fafnir's six plants including these 10 HP and ½ HP units, offer on-the-spot proving-grounds for electric motor bearing designs.

FAFNIR
BALL BEARINGS

NEW CATALOGUES

• Yours for the asking . . . use postcard inside back cover

Continuous Mill Process

Innocenti Corporation, New York City. Bulletin No. 212 presenting information on the continuous mill process for the manufacture of seamless steel tubes. Included is a chart on outputs obtainable in the manufacture of standard gas pipes.

Circle **Item 501** on Inquiry Card

Threading Machine

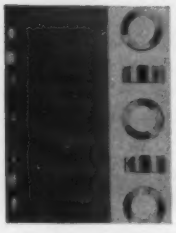
Gisholt Machine Co., Madison, Wis. Bulletin No. 1226 describing the Cri-Dan Model E high-speed, semiautomatic, single-point threading lathe. With very simple controls, the Cri-Dan generates accurate lead and thread forms of all types.

Circle **Item 502** on Inquiry Card

Precision Boring Machine

Pope Machinery Corporation, Haverhill, Mass. Bulletin S-21 on the Model 10-6 opposed-head precision boring machine. Features include two horizontal boring heads and the Pope electric programmer, a separate control center for fully automatic cycling.

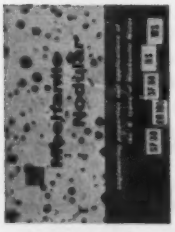
Circle **Item 503** on Inquiry Card



Steel, Cast-Iron Collars

Standard Pressed Steel Co., Jenkintown, Pa. Bulletin No. 2638 on Hallowell steel and cast-iron shaft collars gives specifications for sizes up to 4 15/16-inch bore diameter, including two new miniature sizes for 1/16- and 3/32-inch diameter shafting.

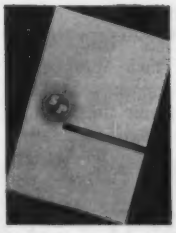
Circle **Item 504** on Inquiry Card



Nodular Iron

Meehanite Metal Corporation, New Rochelle, N. Y. Bulletin No. 47 giving descriptions on five different types of Meehanite nodular iron. Included are examples of castings made of this metal, the "S" types being described in detail.

Circle **Item 505** on Inquiry Card



Precision Casting Technique

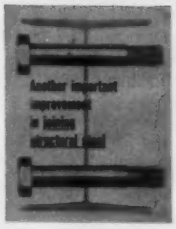
Shaw Process Development Corporation, Port Washington, N. Y. Fifty-six-page brochure presenting the Shaw Process precision casting technique, a method for producing large metallic products with high strength and close dimensional tolerances.

Circle **Item 506** on Inquiry Card

Speed Reducers

U. S. Electrical Motors, Inc., Los Angeles, Calif. Brochure No. F-2003 containing information on shaft-mounted geared speed reducers, as well as descriptions of the U. S. Shaftmount Syncrogear. Tables are included showing service classifications.

Circle **Item 507** on Inquiry Card



High-Strength Bolt

Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y. Catalogue describing the company's new high-strength bolt. Larger head and shorter thread length of the bolt design offer advantages for erectors, fabricators, and designers.

Circle **Item 508** on Inquiry Card

Diamond Wheels and Tools

Delta Diamond Wheel Corporation, Brooklyn, N. Y. Diamond wheel and tool catalogue No. 720, listing standard types of wheels which could be furnished in either man-made or natural diamonds. Included are new and old type designations.

Circle **Item 509** on Inquiry Card

Grinding and Polishing Machines

Hill Acme Co., Cleveland, Ohio. Brochure giving information on the company's two-roll vertical abrasive belt grinding and polishing machines. It illustrates the standard machines, as well as giving details of each type of machine.

Circle **Item 510** on Inquiry Card

Tool Steel

Peninsular Steel Co., Detroit, Mich. Twenty-eight-page "Tool Steel Comparison Guide," with tool steels listed according to AISI-SAE classifications. Included is an index reference, listing tool steels by trade name, classification, and number.

Circle **Item 511** on Inquiry Card

Spindles and Boring Machines

Pope Machinery Corporation, Haverhill, Mass. Bulletin S-18 featuring Pope's precision spindles—grinding, boring, milling, drilling, cutting, belt-driven, etc. Also included is information on the company's precision boring machines.

Circle **Item 512** on Inquiry Card

• Yours for the asking . . . use postcard inside back cover

Chucks

Cushman Chuck Co., Hartford, Conn. Bulletin No. 800 on Cushman power and manually operated two-jaw indexing chucks for multiple precision machining operations on gate and globe valve bodies, bottle molds, etc., in one chucking operation.

Circle **Item 513** on Inquiry Card

Thread-Rolling Machines

Prutton Corporation, Cleveland, Ohio. Catalogue on the company's planetary thread-rolling machines, covering such applications as thread-rolling, roll-forming, marking, serrating, and necking of bolts, screws, nails, and special parts in many sizes.

Circle **Item 514** on Inquiry Card

Offset Boring Heads

Everede Tool Co., Chicago, Ill. Catalogue describing a line of precision offset boring heads which bore deep shallow with one standard length boring-bar and are interchangeable for use on jig borers, boring mills, or turret lathes.

Circle **Item 515** on Inquiry Card

Cutting Tools

F & D Tool Co., Inc., Three Rivers, Mass. Catalogue presenting special cutting tools, including plain milling cutters—light and heavy; helical milling cutters; side milling cutters—staggered tooth, half-side, interlocking; and metal slitting saws.

Circle **Item 516** on Inquiry Card

Hole Punching Units

Punch Products Corporation, Buffalo, N. Y. Catalogue A giving information on Unipunch Series A and AH hole-punching units and Unipunch Series A notching units. All units have standard 8 3/8-inch shut height and 3 1/2-inch die height.

Circle **Item 517** on Inquiry Card

Pillow Blocks

Torrington Co., South Bend, Ind. Catalogue 860 describing their self-aligning, spherical roller bearing pillow blocks. Included are specification charts, exponential bearing-life formula, and guide to lubrication of spherical roller bearings.

Circle **Item 518** on Inquiry Card

Presses

Lempco Industrial, Inc., Bedford, Ohio. Folder on utility presses. Platen and shop presses are shown, manually operated and electrically driven, single and double action. The 700 series of Lempco presses are general utility models.

Circle **Item 519** on Inquiry Card

Index Tables

Cincinnati Gilbert Machine Tool Co., Cincinnati, Ohio. Bulletin on new additions to their line of hand- and power-revolving index-tables. All hand-revolving tables are now equipped with an air-oil mist which lifts off-center loads.

Circle **Item 520** on Inquiry Card

Press Brakes

Steelweld Machinery Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio. Revised Catalogue No. 2023-B presents Steelweld mechanical press brakes, covering the latest features and new models added to the Steelweld press line.

Circle **Item 521** on Inquiry Card

Precision Parts

Van Keuren Co., Watertown, Mass. Buyers catalogue and price list 36B (Section L) giving information on Van Keuren precision parts and lapping. Described are carbide pivots, valve parts, pistons, precision spacers, and precision pins.

Circle **Item 522** on Inquiry Card

Phosphor Bronze

Riverside-Alloy Metal Division, H. K. Porter Co., Inc., Riverside, N. J. Catalogue giving complete information on phosphor bronze wire, bars, rods, strip, sheets, etc. Flexograin, a special fine-grain phosphor bronze, is discussed in detail.

Circle **Item 523** on Inquiry Card

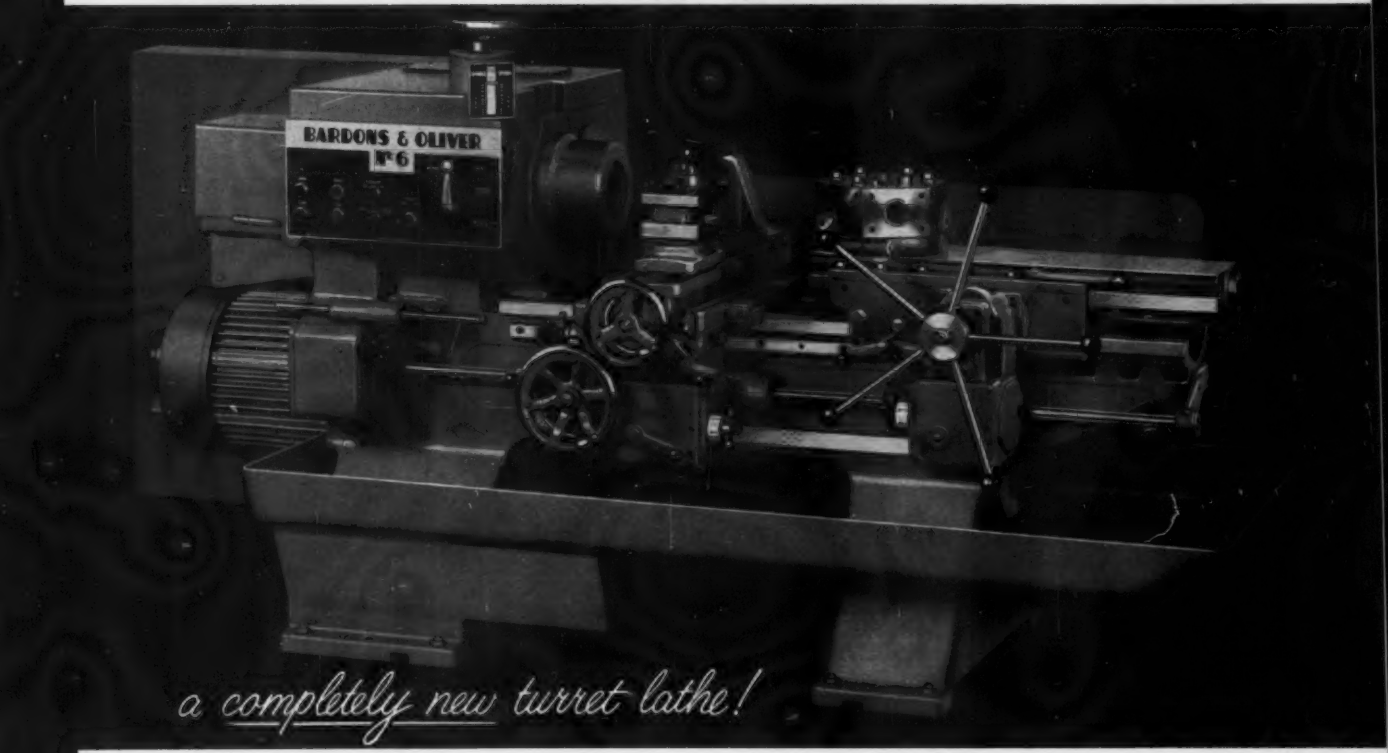
Presses

Havir Mfg. Co., St. Paul, Minn. Catalogue covering their line of Hi Production automatic presses. Features include press feeds, frame construction, expanded bed, air clutch and spring applied brakes, etc. The line ranges from 5 to 200 tons.

Circle **Item 524** on Inquiry Card

NEW BARDONS & OLIVER No. 6
RAM TYPE TURRET LATHE

- 3 INCH COLLET CAPACITY FOR HEAVY DUTY BAR WORK
- 5 INCH COLLET CAPACITY FOR LIGHT DUTY BAR WORK
- 21⅛ INCH SWING OVER BED WAYS



a completely new turret lathe!

New bed, headstock, tool carrying units and aprons are properly proportioned and integrated to produce a truly functional lathe. It offers greater metal removal capacity, while holding today's most demanding tolerances!

In the design of this lathe, the operator was not overlooked. The number of operating controls has been reduced—grouped by function—scientifically located within easy reach. Generous use of aluminum and redistribution of weight results in improved balance and freer traverse of tool carrying assemblies.

For more information on how the new No. 6 can speed up your machining operations and build increased profits, contact the nearest Bardons & Oliver representative or write directly to our home office.

Bardons & Oliver, Inc., 1133 West 9th Street
Cleveland 13, Ohio

NO. 6 FEATURES

- Sixteen Geared Spindle Speeds—50 to 1 speed range
- Constant Horsepower (optional to 30) at all spindle speeds
- Fully Automatic spindle speed changes
- Twelve Fast Feed Changes for cross slide, carriage and hexagon turret
- Single Dial Feed Selectors on both aprons
- Power Rapid Traverse to the cross slide

BARDONS & OLIVER

Manufacturers of Turret Lathes and Cutting-Off Lathes

• Yours for the asking . . . use postcard inside back cover

Metal-Cutting Tools

National Twist Drill & Tool Co., Rochester, Mich. Catalogue entitled "Tools vs. Tools *Plus*," a vignette of the company presenting glimpses of the organization's facilities and various activities for the making of metal-cutting tools.

Circle **Item 525** on Inquiry Card

Precision Machining

Mechanical Specialties Co., Los Angeles, Calif. Folder on the company's services in high-precision machining of small or large parts, mass-production or single prototype. Featured are tape-controlled Fosmatic jig borer and Burgmaster turret drill.

Circle **Item 526** on Inquiry Card

Canton Products and Services

Canton Malleable Iron Co., Canton, Ohio. Brochure describing company's products, services, and facilities outlines plant expansion and modernization program. A variety of their standard malleable and pearlitic castings is shown.

Circle **Item 527** on Inquiry Card

Comparator

Standard Gage Co., Inc., Poughkeepsie, N. Y. Bulletin No. 60-2 presenting the company's P. D. indicating comparator, which provides three-wire inspection on a production basis. Also included is a buyer's guide on Standard's wire carriers.

Circle **Item 528** on Inquiry Card

Rotating Shaft Seals

Cartriseal Corporation, Lincolnwood, Ill. Brochure featuring the company's line of rotating shaft seals. Details are given on various types—bellows, boot, cartridge, grommet, etc.—and there is a description of the Cartrilamp monochromatic light source.

Circle **Item 529** on Inquiry Card

Screwdriving and Nutsetting Tools

Master Power Corporation, a Black & Decker subsidiary, Solon, Ohio. Catalogue entitled "Master Power Portable Air Tools for Screwdriving and Nutsetting"—a complete tool-selection manual covering torque ranges from 2 to 160 inch-pounds.

Circle **Item 530** on Inquiry Card

Wheel Dressers

L. Newman, Oakland, Calif. Catalogue showing all of the company's tangential angle wheel dressers and parts. Included are surface grinder dressers for use with or without magnetic check, handtype dressers, and rotary type grinder dressers.

Circle **Item 531** on Inquiry Card

Shearing and Forming Machines

American Pullmax Co., Inc., Chicago, Ill. Circular on the company's line of five universal shearing and forming machines for straight, circular, and irregular shearing; plus slotting, folding, beading, joggling, edge bending, and louver cutting.

Circle **Item 532** on Inquiry Card

Toolposts and Tool-Holders

Rhucor, Pasadena, Calif. Bulletin presenting Bakewell master toolposts and tool-holders. Advantages claimed are greater rigidity, positive grip on the tool-holder, closer tolerances, reduction of machining time, and easy installation.

Circle **Item 533** on Inquiry Card

Timing Drive Selection

T. B. Wood's Sons Co., Chambersburg, Pa. Bulletin 21103 presenting a method involving a minimum of mathematics for the selection of a drive to fit any application. Included in the bulletin are five sets of curves for drive-width selection.

Circle **Item 534** on Inquiry Card

Spiral Bevel Gears

Arrow Gear Co., Downers Grove, Ill. Bulletin SBG giving engineering data, sizes, and specifications on standard spiral bevel gears listed as available from company stock. Gears and pinions are proportioned according to the Gleason spiral bevel gear system.

Circle **Item 535** on Inquiry Card

Vibrating Feeders

Link-Belt Co., Chicago, Ill. Folder 2770 giving information on the company's straight line vibrating feeders, which incorporate a new principle of vibration for high-capacity, controlled feeding of heavy and highly abrasive bulk materials.

Circle **Item 536** on Inquiry Card

• Yours for the asking . . . use postcard inside back cover

Spur Gears

Pic Design Corporation, a subsidiary of Benrus Watch Co., Inc., East Rockaway, L. I., N. Y. Technical booklet No. 5 outlining specifications established on low-inertia, custom-made, certified military type, fine-pitch spur gears.

Circle **Item 537** on Inquiry Card

Diamond Tools

Precision Diamond Tool Co., Elgin, Ill. Comprehensive catalogue presenting information on the company's diamond tools. Sections included are: Catalog Tools, Catalog Economy Tools, Catalog Wheels, Technical Reports, Special Applications, etc.

Circle **Item 538** on Inquiry Card

Variable-Speed Drives

Browning Mfg. Co., Maysville, Ky. Catalogue (MVP-101-A) covering the company's new line of "MVP" variable-speed drives. Features described include 360-degree adjustment, patented locking ring assembly, concentric grooves, ground barrels, etc.

Circle **Item 539** on Inquiry Card

Cylindrical Grinder

Van Norman Machine Co., a division of Van Norman Industries, Inc., Springfield, Mass. Catalogue presenting information on the company's 418 cylindrical grinder for diversified, close-tolerance grinding during short runs or high production.

Circle **Item 540** on Inquiry Card

Drives

Maurey Mfg. Corporation, Chicago, Ill. Catalogue SW-1 on "Super Wedge" drives, containing data for proper drive selection and installation. Drive selection tables and horsepower ratings covering belts, sheaves, and bushings are given.

Circle **Item 541** on Inquiry Card

Torque Control Equipment

Chicago Pneumatic Tool Co., New York City. "One-Shot Torque Control," catalogue explaining the theory of torque-control equipment and describing their assortment of CP screwdrivers, nut-runners, multiple-runner motors, and impact wrenches.

Circle **Item 542** on Inquiry Card

Milling Cutters

Visual Arts, division of Valeron Corporation, Royal Oak, Mich. Catalogue listing nearly 500 throw-away insert milling cutter styles and sizes. Cutter bodies, cartridges, inserts, and accessories for milling cast iron, steel, etc., are described.

Circle **Item 543** on Inquiry Card

Speed Reducers

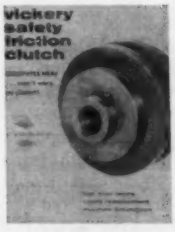
Winsmith, Inc., Springville, Erie County, N. Y. Catalogue No. HM 60 on their "HM" series horizontal, motorized differential speed reducers. Engineering data, mounting information, service factors, horsepower, and torque are included.

Circle **Item 544** on Inquiry Card

Drilling Machines

Burg Tool Mfg. Co., Gardena, Calif. Circular giving information on the Burgmaster automatic hydraulic, tape-controlled, six-spindle turret drilling machine. Described are Models 25AH-T and 25AH-L, with 1 1/4-inch capacity in steel.

Circle **Item 545** on Inquiry Card



Safety Friction Clutch

Vickery, Norwalk, Ohio. Bulletin presenting their new torque-controlling friction clutch which combats distortion by dissipating heat through a one-piece cast-iron hub and pressure-plate. A complete range of standard sizes is offered.

Circle **Item 546** on Inquiry Card

Gear-Shaving Machines

Michigan Tool Co., Detroit, Mich. Bulletin No. 870-60 describing their new line of Mark II gear finishers. Covered are the methods of shaving that can be used—underpass, transverse, and modified underpass—and procedures for simplifying setup.

Circle **Item 547** on Inquiry Card

Press

General Automation Corporation, Flushing, N. Y. Brochure featuring details on the company's A3-MC Trippit power press which covers all types of power press operations. General Automation's A3-FCA model press brake control is also illustrated.

Circle **Item 548** on Inquiry Card

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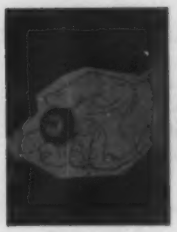


Bearings

Tann Bearing Co., Detroit, Mich. Brochure with charts and diagrams on Hy-Film line of packaged bearings which run on hydrodynamic oil films. Also described is an electron bearing analyzer used to test bearings and compute their characteristics.

Circle **Item 549** on Inquiry Card

Injection Molding Machines

National Automatic Tool Co., Inc., Richmond, Ind. Bulletin No. 1000 illustrating the Natco line of plastics injection molding machines in action at molding plants throughout the country. Specifications and advantages of the equipment are given.

Circle **Item 550** on Inquiry Card

Rubberized Abrasives

Cratex Mfg. Co., Burlingame, Calif. Application manual which includes information concerning the many uses for rubberized abrasives, case histories on a variety of typical applications, and a copy of the latest Cratex catalogue.

Circle **Item 551** on Inquiry Card

Grinders

Gardner Machine Co., Beloit, Wis. Catalogue presenting information on a new line of Gardner valve grinder, including Models 3H30 and 2H40. Featured is a description of the company's abrasive discs with high-strength, heat-resistant BK bond.

Circle **Item 552** on Inquiry Card

Grinder

Covel Mfg. Co., Benton Harbor, Mich. Bulletin 35B60 on the No. 35B 8- by 24-inch hydraulic surface grinder. Its most outstanding feature is the additional capacity under the wheel. Power elevation to wheel-head is available as optional equipment.

Circle **Item 553** on Inquiry Card

Numerically Controlled Machines

Ex-Cell-O Corporation, Detroit, Mich. Booklet containing general information on numerically controlled machine tools, and describing three specific types of machines (having continuous-path control) for milling, grinding, and boring.

Circle **Item 554** on Inquiry Card

Cutoff Machines

Allison-Campbell Division, American Chain & Cable Co., Inc., Bridgeport, Conn. Bulletin DH-460-C featuring the company's abrasive cutoff machines. A chart is included giving specifications of machines used for both wet and dry cutting.

Circle **Item 555** on Inquiry Card

Granite Surface Plates

Victor Brook Co., Rochester, N. Y. Bulletin No. 4B giving information on their full line of black granite surface plates; "Toughboy" welded stands; and Brook "Re-Caps," thinner granite plates which are bonded to worn-out iron plates.

Circle **Item 556** on Inquiry Card

Square Barrel Cylinder

Galland-Henning, Nopak Division, Milwaukee, Wis. Catalogue No. 107 describing the company's line of air and hydraulic cylinders perfectly square on the outside, with each of their four sides flush and flat for many mounting possibilities.

Circle **Item 557** on Inquiry Card

Steel Bars

LaSalle Steel Co., Chicago, Ill. Case study portfolio giving applications of "Fatigue-Proof" steel bars in metalworking machinery and equipment parts. Each case study describes the machinery, specific part involved, and material it replaced.

Circle **Item 558** on Inquiry Card

Milling and Boring Machines

Mitsubishi Shipbuilding & Engineering Co., Ltd., Chiyoda-ku, Tokyo, Japan. Catalogue on Mitsubishi Innocenti CWB milling and boring machines. They may be adapted to the user's requirements by employing standard elements of the machines.

Circle **Item 559** on Inquiry Card

Metal Chip Handling Systems

Link-Belt Co., Chicago, Ill. Book 2926 on metal chip handling systems for automatic continuous crushing and deoiling of metal chips and turnings. Included are photographs of custom-engineered systems for large and small plant operations.

Circle **Item 560** on Inquiry Card

Take the

Out of Tool Steel

With the A-L Steelector System

How can you pick the right tool steel when there are more than 1000 brands, each jostling for your attention? And how can you pick a tool steel and know before you order that the grade you want is available—without delays—in the size and shape you need?

If you are tired of wrestling with these problems you will like the new Allegheny Ludlum Tool Steel STEELECTOR Program. With it you can accurately select a tool steel that will meet your requirements and be sure that you have picked a grade that is in stock . . . as near as your warehouse source.

It's easy to make accurate selections with the STEELECTOR Program. The three STEELECTOR cards—covering general purpose tool steel applications, hot work applications, and high speed grades—show at a glance the comparative properties of tool steel grades that will suit 96% of all tool steel applications listed in the A-L Tool Steel Handbook.

The STEELECTOR cards use bar graphs to make it easy to make precise comparisons of abrasion resistance, toughness, size stability, machinability, and red hardness. All you have to do is pick the grade with the particular combination of properties you need for the job at hand.

For each grade, there is a Data Stock List that tells you the exact analysis of the grade, its basic properties, typical applications and their working hardnesses, and temperatures for hardening, tempering, and annealing. And the complete range of available sizes and shapes is listed.

You can count on getting quality tool steel by using the STEELECTOR Program. Each STEELECTOR grade has been selected from the complete line of Allegheny Ludlum Tool Steel and made under the exacting quality control standards of all A-L products.

The new A-L Tool Steel STEELECTOR booklet contains the STEELECTOR Cards, descriptions of the various grades, and explains the individual Data Stock Lists available for every grade. For your own copy ask your Allegheny Ludlum sales representative, or write: *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. M-10.*

STEELECTOR PROGRAM

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country

AL

2094

For more data circle this page number on card at back of book

By E. S. Salichs

BETWEEN GRINDS

Alexander Luchars—Scion of a Distinguished Ancestor

From the day that Alexander Luchars founded MACHINERY back in September, 1894, his name became a symbol of integrity throughout the technical publishing field and the machine tool industry to which his publishing efforts were directed. His name has been brought back into circulation with the birth of a great-grandson on August 25. The proud father is Robert B. Luchars, Jr., who is with THE INDUSTRIAL PRESS, publishers of MACHINERY. The grandfather is Robert B. Luchars, president of THE INDUSTRIAL PRESS. Baby Alexander has a big name to live up to—MACHINERY's staff congratulates him on the goal that he can set up for himself in the years to come.

They Have the Answer

A computer laboratory within the engineering department has been set up by the National Broach & Machine Co. Gear production tools, stated President Walter S. Praeg, because of their complex involute-curved tooth shapes, have traditionally required more mathematical calculations than any other tools used by the metalworking industry, and gear production equipment makers need modern electronic brains to carry out today's research and design programs.

In a Russian Garden

"Sunflower seed is the most important oil-bearing crop in the USSR," says a report of the Twentieth Century Fund. Which brings to mind the sunflowers you used to see along fences and sides of houses. Sent to Siberia, were they?

Baby Batches

Steelways tells about a small company that is producing "instant" steel by wedding oxygen converters and hot blast cupolas. Seems the company in question was unable to obtain semifinished steel from its suppliers who were expanding their facilities. So, in self-defense as it were, they originated this process which for the first time merged the two units—molten metal flows from the cupolas continuously, and the converters can make a heat of steel every forty minutes. It probably all started over a cup of coffee—instant, of course!

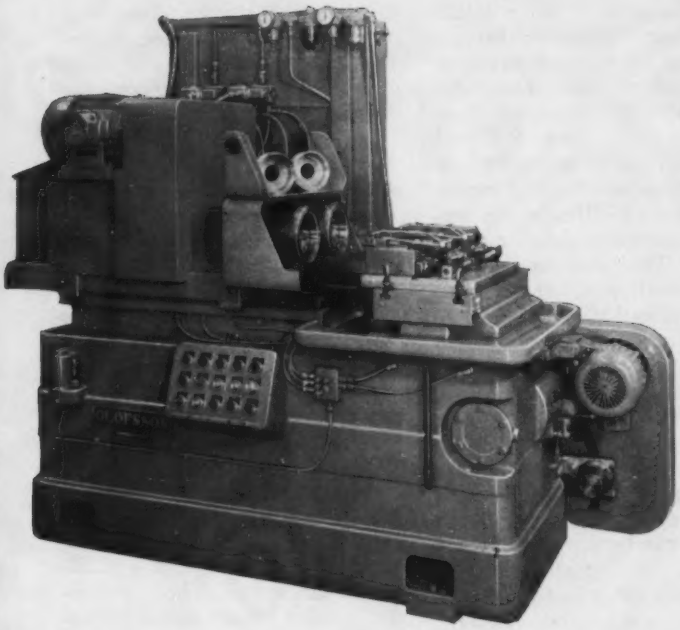
Slangology

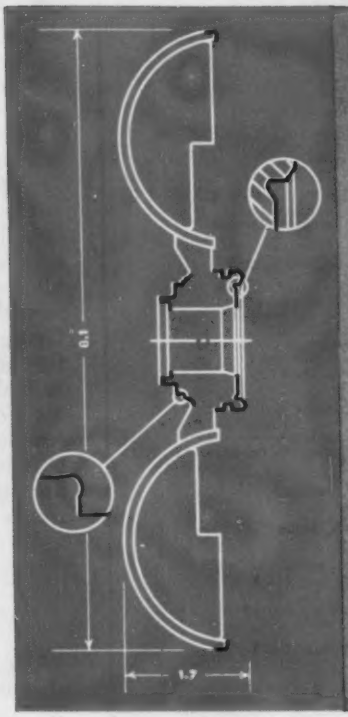
From the *Kaiser Builder* we repeat some definitions of colorful terms used by construction men: *cherry picker*—a mobile crane; *cutie pie*—hand-held Geiger counter; *fast daughter*—second-generation radioactive isotope with a short half-life; *gunk*—undesirable nondescript material, usually semisolid, in a chemical process; *headache ball*—heavy metal ball swung from crane boom for demolition work; and *monkey on a stick*—bucket mounted on single tower or mast for the purpose of hoisting concrete.

FAIR FEATHERWEIGHT—Jigmil IV, the world's largest aluminum yacht, displays functional beauty in test runs where she reached 22.8 miles per hour—a record for her class. Named after the machine invented by her proud owner, C. F. DeVlieg, board chairman, DeVlieg Machine Tool Co., the yacht is 72 feet 2 1/2 inches long, with a beam of 17 feet 8 inches and a draught of only 5 feet. She represents a degree of performance achieved principally by saving 8 tons of useless weight through the use of Reynolds aluminum in her hull, superstructure, cabin, furniture, and wherever else possible.

Announcing the

NEW OLOFSSON MODEL 41, AIR-OPERATED CAM-CONTROLLED MACHINE





***Part:* TORUS**

Operations Performed:
Facing, chamfering, boring, undercutting and grooving.

Rate of Production:
170 pieces per hour *(at 80% efficiency).*

ONE MACHINE FOR EACH SIDE OF PART. TWO SPINDLES PER MACHINE.

Bores, Turns, Contours and Faces with new efficiency and economy

Designed for generating accurate contours mechanically, the Olofsson Model 41 brings new efficiency and economy to boring, turning, contouring and facing operations like those diagrammed above. Its low height to width ratio of spindles to ways provides maximum stability and smoothness to *repetitive* machining operations. And, on multiple operations it is necessary to check just one dimension from each tool used, all other dimensions will be in relation.

The cam-controlled stroke is 4" on both main and cross slides. Cams are mounted on the same shaft, and both table slide and cross slide are in *direct contact* with their respective cam. No linkage is involved. Both cams and cam followers are completely submerged in oil; can be quickly and easily changed.

All machine functions are electrically interlocked. Air power supply is from 70 p. s. i., minimum.

Your Olofsson representative will be glad to suggest profitable applications for your operation. Call him, or contact Olofsson *in Lansing.*

Descriptive literature on the Model 41 is yours for the asking. Write today.

THE LOFSSON CORPORATION
2729 Lyons Avenue, Lansing, Mich. Phone TUrner 2-0265

Manufacturers of precision boring and special machinery

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operated with from two to eleven spindles and converts any single-spindle drill press into a high-production, multiple-spindle machine. It is more flexible and offers a larger work area than previous models. As with all Knuckle-Heads, the new model will perform either drilling or tapping operations by utilizing easily interchangeable Ettco faceplates. The lightweight, compact head has a capacity of up to 5/16 inch in steel and can be set to any hole pattern in an area 6 by 12 inches.

Ettco Knuckle-Heads are well adapted for either short or medium runs. They can be operated at top speed in either direction without vibration, regardless of spindle location. An exclusive feature is the one-shot lubrication on all wearing points which insures smooth running and long life. Guide bushings are provided in the gear case for extra rigidity and alignment when guide rods are required. Jig-bored aluminum templates can be supplied instead of spindle locating arms when a fixed spindle setup is desired.

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C & J Lathe Features All-Geared Head

C & J Master Model lathes, manufactured by the Carroll-Jamieson Machine Tool Co., Batavia, Ohio, have all-geared headstocks designed for convenience, power, and durability. Twelve spindle speeds from 20 to 900 rpm are obtained through two speed-control handles. Gears are heat-treated alloy steel, and shafts are accurately ground special steel. The taper-nose spindle is of the standard LO type and is mounted in precision taper roller bearings. The headstock is lubricated by a splash system, with all parts running in an oil bath. Oil level is checked by window type indicator.

The oil-tight cover is easily removed. A new improved friction type clutch and brake instantaneously controls the spindle, allowing the motor to run continuously. The clutch and brake control handles are conveniently placed, and the apron control handle on 10-, 12-, 14- and 16-foot lathes permits spindle control from the apron at any position along the bed. At 100 rpm, the front spindle bearing takes a 6622-pound radial load and a 5227-pound thrust load. The rear spindle bearing takes a radial load of 5681 pounds and thrust load of 3776 pounds. Two different sizes of lathes are available, the Master Model GH 16-inch (illustrated) and Master Model GH 18-inch.

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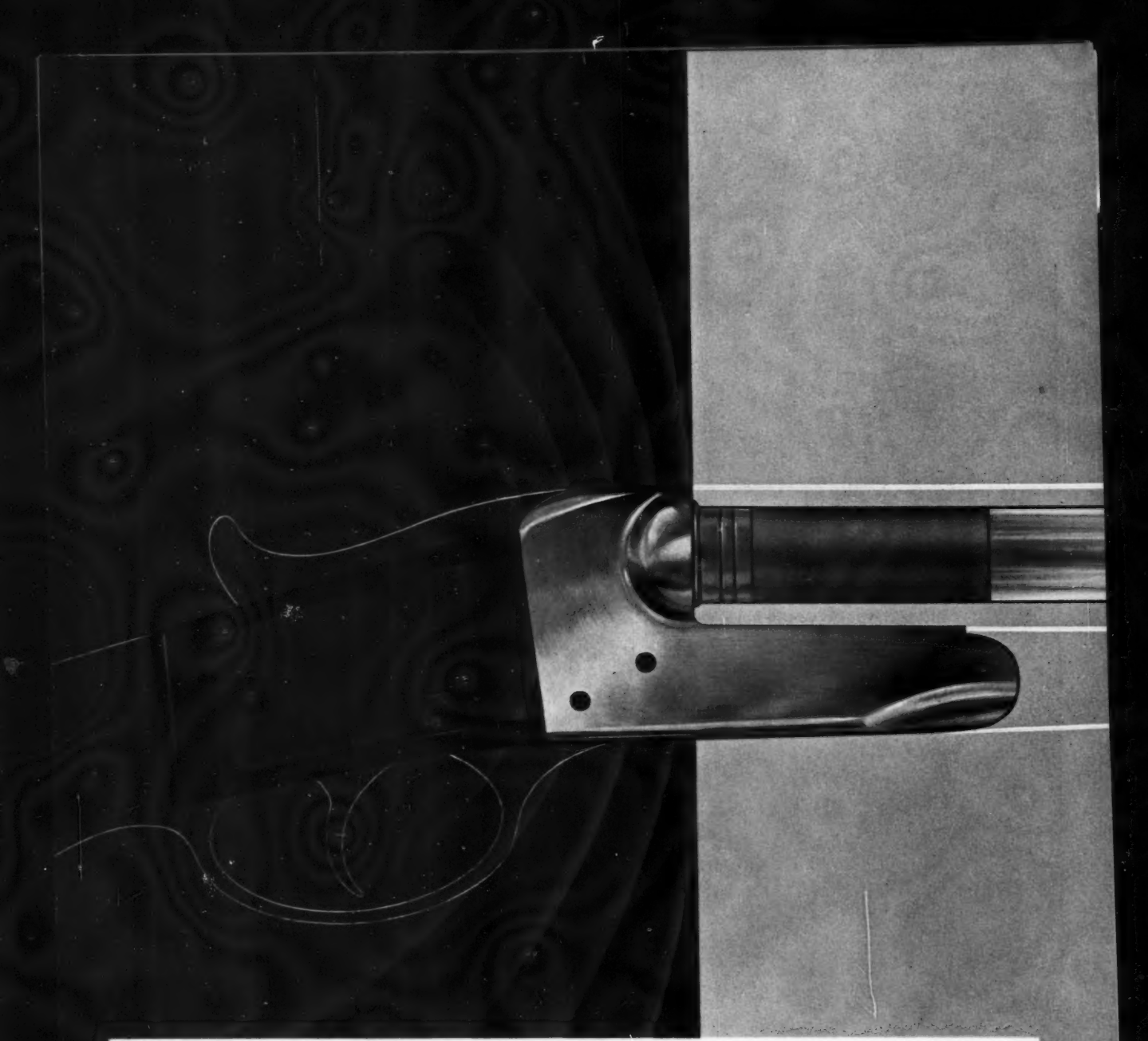
(Continued on page 230)

All-geared head lathe made by Carroll-Jamieson Machine Tool Co.



Pressure on the face of this Malleable iron receiver approaches 5 tons per square inch each time this 12 gauge shotgun is fired.

For Really Tough Parts...Use Malleable

With high powered charges being fired just inches from your face, you don't want parts that can't take it. That's why so many weapon parts are made of tough Malleable iron castings.

Tremendous resistance to impact, fatigue, deflection, and wear also makes Malleable castings favorites among manufacturers of mining and construction equipment, heavy-duty tools, and other products that require extra tough components.

Have you investigated how Malleable castings will improve your product's performance and cut costs at the same time? If not, send drawings or outline of your requirements to a nearby Malleable castings producer who displays this symbol —

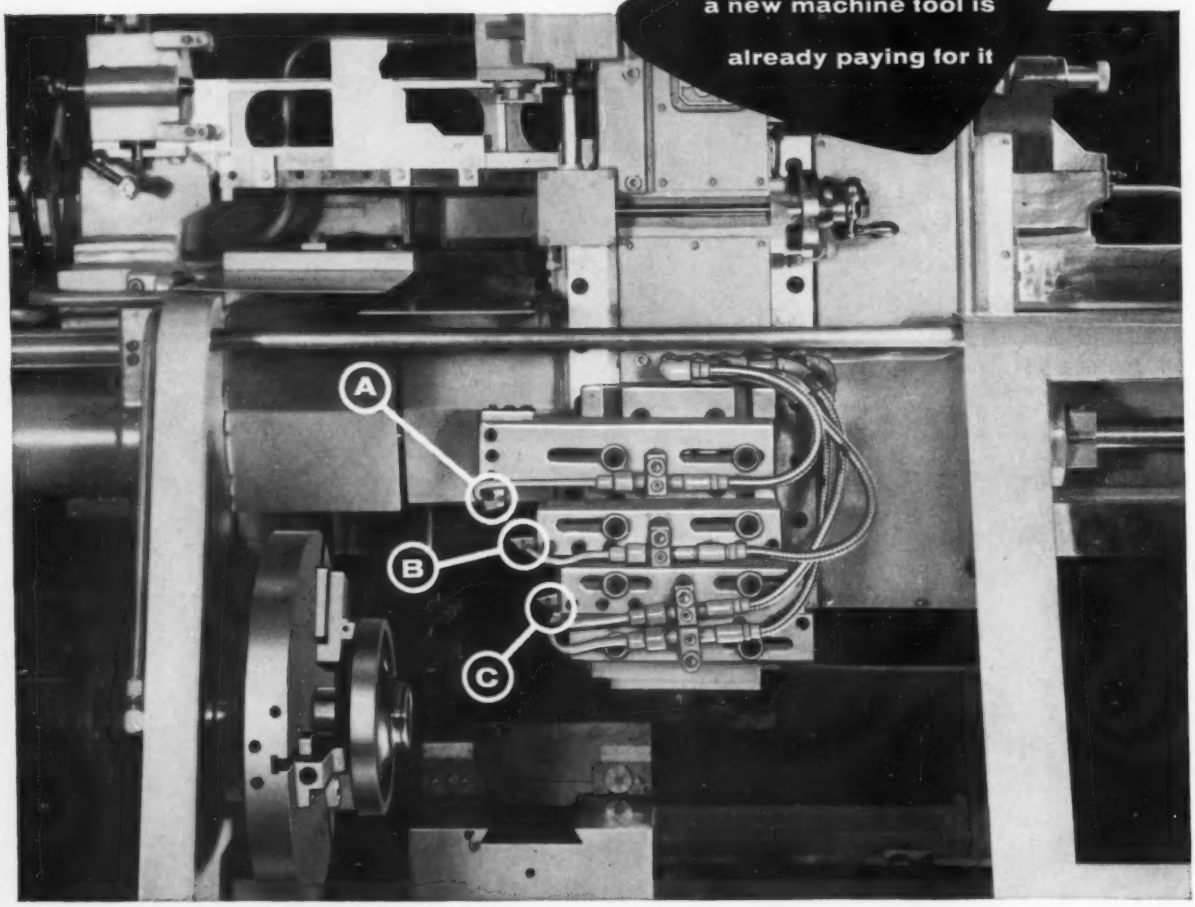
MEMBER

MALLEABLE CASTINGS COUNCIL

For detailed information on "Toughness", contact any of the progressive companies listed on the opposite page, or Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio.

JONES & LAMSON MACHINE TOOLS

the man who needs a new machine tool is already paying for it



Multiple Tool for a Fully Automatic Two-Dimensional Tracing Cycle

The two-dimensional tracing slide on the new Jones & Lamson Model 30 Automatic Tracing Lathe provides a new opportunity for multiple tooling on tracing operations. In addition, this slide offers eight different tracing cycles for tool motion — each of which controls tool travel through a full 180° of motion.

Automatic speed and feed changes during a cut allow for the proper cutting speeds on varying diameters, resulting in longer tool life, better cycle time, and desired surface finish. *For Example:* The illustration above shows the machine as it is tooled up for one of a variety of sizes of gear blanks. Three tools on the tracing slide machine the various surfaces of the blank in one completely automatic cycle. Tool "A" approaches the work first. It chamfers and turns the O.D. At the end of the turn, tool "C" is in position to chamfer and face the contour of the hub. As this is completed, tool "B" faces the piece, contours the large radius at the flange and faces the flat surface at the face of the gear blank O.D. Automatic speed and feed changes may occur as each tool is engaged.

Multiple tooling of tracing operations not only shortens tracing cycles, but also offers the opportunity for proper tool geometry for each particular phase of the operation. Set-up from one job to another is accomplished in a matter of minutes by graduated dog rings on the conveniently located control drum.

You can get detailed information now by writing for Catalog No. LO-6011. Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

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UNIONARC

REDESIGNED...REBUILT...RELIABLE

Development of a LINDE welding process does not stop with its introduction. In the past 18 months, we have invested over 3000 laboratory manhours to further improve the UNIONARC welding process and equipment. New: portable UAM-2 machine, simplified UAW-2 torch, refined consumables. Improved equipment for an improved CO_2 steel welding process, featuring

- **...wear-resistant flux and wire-guide tubes, super-hard "Stellite" torch body**
- **...automatic flux-CO_2 shutoff valve for precise flow of consumables**
- **...stainless-steel hopper funnel for smooth flux feed**
- **...serrated V-groove drive roll (patent pending) for positive wire feed**
- **...miniature machine—300 lbs. lighter, uses 50% less space**
- **...refined flux that increases metal deposition rates**
- **...proven results: dependable operation with minimum maintenance.**

For field-tested application details, see next page

UNIONARC

Portable machine... produces 30-ipm... top-quality welds

One of the nation's largest construction-equipment manufacturers field-tested 15 UNIONARC UAM-2 machines full time—three shifts a day, six days a week—over 2000 hours per week. Maintenance has averaged less than ½ hour per machine per week, a downtime factor of less than .005 per cent. This is tested reliability that insures process advantages:

- ...cost as low as 27¢/lb. of metal deposited
- ...deposition rates as high as 25 lb./hour
- ...speed over 30 ipm on ¼ in. carbon-steel fillets
- ...quality to strictest specifications—ASME, Military, Bureau of Shipping
- ...full penetration requiring less preparation, fewer passes, less wire.

On a production basis, these advantages mean substantial savings. A western pipe manufacturer saved 25¢/ft. of weld on 28,000 feet of welds. A southwestern fabricator reduced welding time on three on-site storage tanks (9500 ft. of welds) from 1850 manhours to only 700 manhours. A northern manufacturer eliminated expensive reworking of code assemblies, gained 100% weld acceptance with UNIONARC compared to 50% to 90% with covered electrodes. A mid-western manufacturer eliminated beveling, and reduced pass and wire requirements on Schedule 40 pipe by 2:1 and 8:1 ratios respectively.

UNIONARC welding is an ideal process for carbon steel. On a production basis, it is unquestionably faster and more economical than other CO_2 or covered electrode processes. It uses a wide range of readily-available, low-cost wires that meet any application need. It uses one flux, one low-cost CO_2 shielding gas. It has the speed and weld quality of manual submerged-arc welding, with the advantage of weld visibility. It is a sound, well-engineered process designed primarily for repetitive, high-production work on carbon steel. For these applications, the new UNIONARC UAM-2 machine offers outstanding cost advantages with a field-proven low-maintenance factor that produces clear-cut profit for its user. For detailed information or a live demonstration, call your nearest LINDE office.

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LINDE COMPANY

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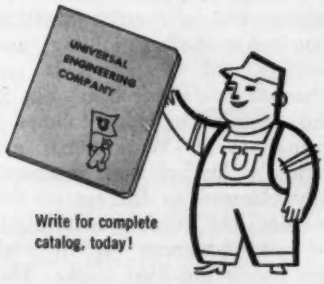
it pays to use UNIVERSAL DRILL BUSHINGS



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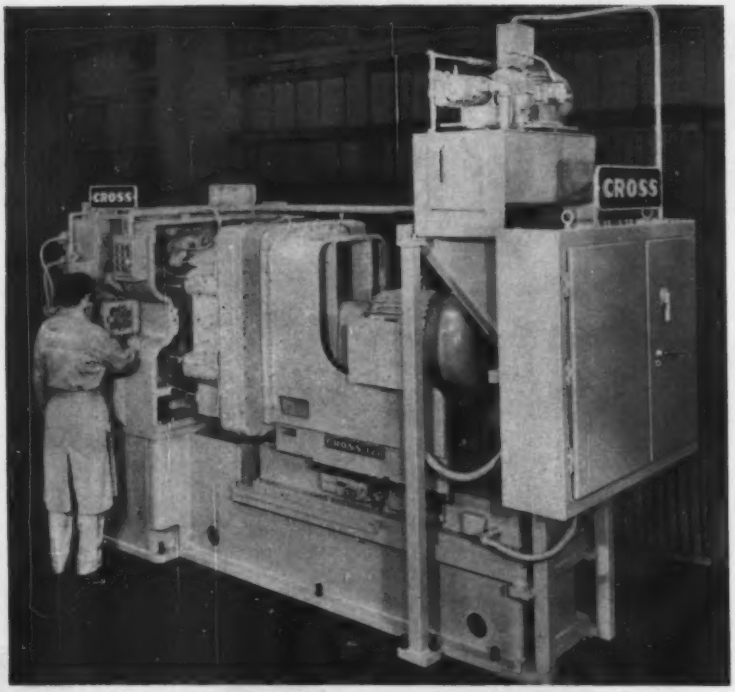


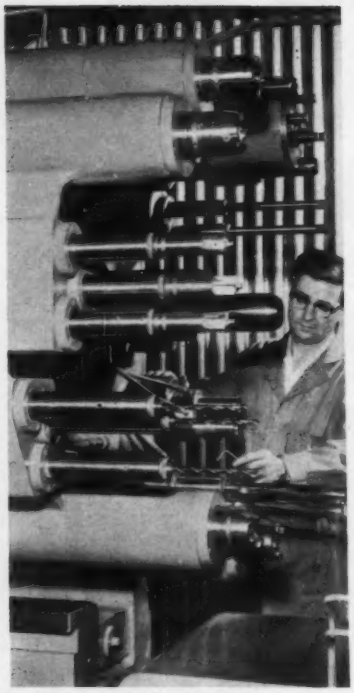


Fig. 1. (Left) Similar in appearance to any other trunnion machine, this Cross model feeds tools at three different rates. Fig. 2. (Right) Eight accelerated spindles are used on this trunnion machine so that individual operations can have optimum feed rates. The set-up man has his right hand on one of the special quills. With the head drawn back, all tools are easily accessible

Trunnion Machine Designed to Feed at Several Rates Simultaneously

The Cross Company, Detroit, Mich., is building trunnion machines that have several different feed rates for individual tools or groups of tools mounted on a single hydraulic feed unit. With accelerated spindles used to obtain different feed rates, individual operations can be set up for best surface finish, minimum tool costs, and maximum tool life. This solution to the problem of mixing different types of operations on a trunnion machine is said to be comparatively inexpensive.

A typical trunnion machine built with this approach, Fig. 1, is used for processing combination clutch and brake master cylinders, which require drilling, spot-facing, hollow milling, and reaming. All of the tools are mounted on a single head, Fig. 2. This trunnion machine follows a normal cycle. Work-pieces are manually loaded and mechanically clamped in fixtures on the trunnion; the trunnion is indexed; the head advances rapidly and then enters the feed stroke. The majority of the tools feed at the basic rate of the feed unit, but several quills feed more rapidly.

The accelerated spindles have an idler pinion fixed on the head. This pinion meshes with two racks (Fig. 3), one cut in the quill, which contains the spindles, and one cut in an actuator bar. At the end of the rapid advance stroke, the actuator bar contacts a stop on the trunnion and stops moving. As the head feeds, the center of the pinion moves along the actuator bar. This causes the pinion to rotate and feeds the quill out with double the rate (and stroke) of the feed unit. A spring, at the end of the actuator bar, keeps the quill and the bar in their retracted positions. When the actuator bar stops moving, the spring is compressed by the continued movement of the head. When the feed unit starts to retract, the spring causes the quill to be returned to its starting position.

Feed rates other than double are achieved by using a differen-

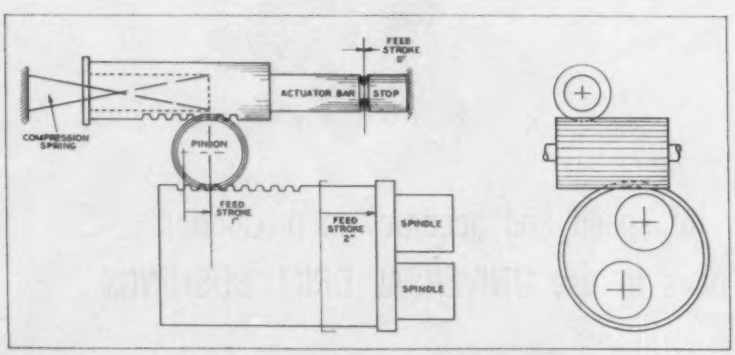


Fig. 3. An idler pinion mounted between two racks doubles feed rate and total stroke of tools mounted in the quill of the machine shown in Fig. 1

At Amana Refrigeration, Inc.

STANOIL

IMPROVES PRODUCTION REDUCES MAINTENANCE

Smooths operation of 600 ton hydraulic press

Situation: The 600 ton Verson Press at Amana is a vital operating component in the manufacture of home freezers and refrigerators. Its proper performance is necessary to the efficiency of Amana's entire manufacturing operation. That's why erratic press operation, caused by foaming of the hydraulic oil, was a serious problem.

What was done? In seeking the solution to this problem, Amana consulted their Standard Oil lubrication specialist who recommended STANOIL for this service. STANOIL Industrial Oil is a top quality, first-line industrial lubricating and hydraulic oil. It will provide excellent service in many different applications. And when tested by Amana, STANOIL proved perfect for use.

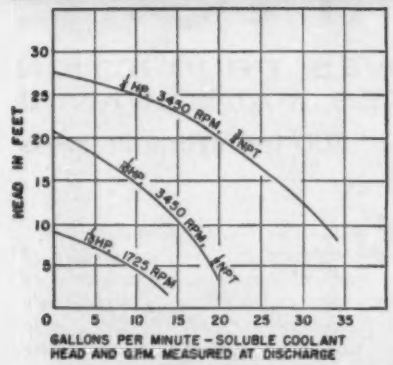
What has happened? Since STANOIL was first put to work at Amana, it has performed for extended periods of time without foaming or oxidation, lengthening the time between drainings and improving press operation. As a result of this record, STANOIL has been adopted for use on other production equipment, together with Standard's RYKON Greases and SUPERLA Soluble Oil.

What you can do: To get help in solving your lubrication problems and to learn more about STANOIL Industrial Oils, simply call the Standard Oil office near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Ill.**

You expect more from STANDARD and you get it!

Standard's Jess Nelson (center) and Gene Maske (left) checking lubrication survey with Leonard Rettig, Amana's plant maintenance superintendent. Jess, who is District Engineer for Standard, is a specialist in this kind of operation. He has an engineering degree from the University of Iowa, and has also graduated from the Standard Oil Sales Engineering School.

FOR MORE COOLANT PUMP ECONOMY*



*Performance Chart

Gusher
Sealess-Type

Gusher flange mounted coolant pumps feature a simple design with no seals, no packing or priming necessary. They are designed to mount on the side of the reservoirs with either external or internal discharge. Immersed type also available.

Model 5-P

RUMACO
Seal Type

Rumaco pumps are seal type, centrifugal pumps that can be mounted in any convenient place. Precision built, Rumaco pumps give efficient, trouble-free operation. Seals are the best obtainable.

Model 5-S

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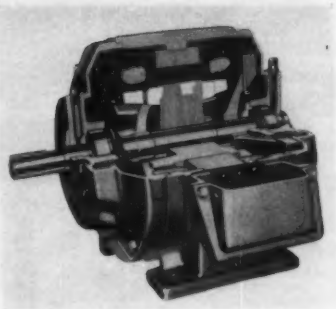
tial pinion. Two pinions are attached together on the same axis so that one meshes with the rack in the actuator bar and the other meshes with the rack in the quill. Depending on the diameters or sizes of teeth in the pinions, feeds can be either greater or less than the rate of the hydraulic feed unit.

Circle 615 on Readers' Service Card

Weatherproof Motor

One of a completely new line of open, weatherproof, alternating-current motors with an epoxy-encapsulated insulation system introduced by Reliance Electric & Engineering Co., Cleveland, Ohio. These "Duty Master" weatherproof motors are currently available in frames 180 through 445U (1 through 125 hp) in all standard speeds and voltages. The stator windings are thoroughly encapsulated in a specially formulated epoxy resin for resistance to moisture, oils, dust, chemicals, acids, and alkalies. The bearings, exposed internal metal surfaces, hardware, and mechanical parts are also protected against damage from the elements and contaminating atmospheres in all types of indoor and outdoor applications. The full Class "B" insulation system is built around the thixotropic epoxy resin which does not change form with heat and is applied by a unique vacuum impregnation process. In the exclusive vacuum impregnation and pressure process, the wound stator core is preheated to drive out gases and moisture, then placed in a pressure vessel and vacuum-drawn. Epoxy resin is then introduced into the vessel to submerge the winding. The vacuum is maintained to allow the resin to penetrate the coil slots and heads. Next, pressure is applied to the submerged core. The stator, now encapsulated in a solid, void-free protective insulation, is removed from the pressure vessel, drained, and baked in large curing ovens. The unique insulation system uniformly coats the motor windings to permit excellent heat dissipation, while producing exceptionally high resistive properties, flexibility, and bond strength. Reliance "metermatic" lubrication



system is employed with the deep-groove, double-shielded ball bearings. A metering plate helps keep out contaminants while regulating the precise flow of fresh grease to the bearing as needed. Automatic grease relief is provided. A special rust-preventive coating is applied to all internal metal surfaces such as the rotor, stator, and air deflectors.

Circle 616 on Readers' Service Card

Cleco Vertical Grinder or Sander

New 1600 series grinder developed by Cleco Air Tools, a division of Reed Roller Bit Co., Houston, Tex. This direct-drive, governor-equipped, air-driven vertical grinder/sander is designed to handle a 6-inch cup wheel. It is actually a combination unit which doubles as either a grinder or sander. The basic grinder and wide assortment of guards can be selected from stock to fit any requirement. The grinder is available in three throttle arrangements. One is the butterfly on-and-off design in which a detent holds the throttle on un-

(Advertisement)

NEW IDEAS IN COPPER ALLOY ROD AND WIRE

Interesting things happen when you add a spot of zirconium or chromium to copper—four high-conductivity coppers that boost production, cut cost of machining—even plain old free-cutting brass rod is going fancy.

There's a quiet revolution going on in copper metallurgy. Research and development teams are expanding the useful knowledge of copper and copper alloys in an effort to define the properties most suitable for specific engineering applications.

STABILITY at elevated temperature, combined with good electrical conductivity, is probably a combination most sought after by design engineers and by our industry's research teams. Two alloys are now commercially available, and the alloy systems are unique. Chromium copper and zirconium copper are heat-treatable alloys with good stability of mechanical properties up to temperatures in the order of 600 F.

CHROMIUM copper in the fully heat-treated condition following a solution anneal will exhibit properties combining a tensile strength of about 75,000 psi with conductivity of approximately 80% IACS. Zirconium copper has good stability characteristics at elevated temperatures and conductivity of 90 to 95% IACS; the strength properties developed by heat treating are, however, somewhat lower than chromium copper.

SEVERAL other heat-treatable copper alloys with intermediate properties are gaining recognition in the connector and electronics fields. These alloys fall into a conductivity range of 35 to 65% IACS, with tensile strengths 90,000 to 100,000 psi. The most popular alloy systems are the copper-nickel-phosphorus and copper-nickel-silicon series with modifications for free machining or other specific requirements. These alloys have a solution annealing temperature about 100 to 200 C lower than the chromium and zirconium coppers.

THE WIDESPREAD use of panel or harness construction for linking segments of electrical control devices has made the requirement for free-cutting coppers mandatory. Screw machine shops are fabricating these connector components of various designs by the millions. Currently the most popular free-cutting coppers are leaded copper with conductivity of about 98% IACS, and tellurium and sulfur coppers at about 95% IACS. Some of these free-cutting coppers have residual oxygen and can become brittle or gassed under the usual conditions contributing to this phenomenon. All, however, can be obtained with a combination of deoxidizers or oxygen-free copper. In the case of the deoxidized variety, some slight sacrifice in conductivity will be noticed. Ordinary usage very seldom requires conductivity in excess of 90% IACS – and this presents no problem for these coppers.

ALL of these coppers can be cold worked without too much trouble. They can be supplied in a suitable wire temper for cold heading and secondary operations designed around the basic alloy system. Up to now there has not been too much interest in these alloys for wire forming or heading operations. Close dimensional tolerances may be the reason for the reluctance of the heading people to get into the electrical connector business. Alloys are available with the ductility and mechanical properties necessary for this type of forming. It would appear that some of the products could be made more economically by cold-heading or wire-forming operations.

RECENT TRENDS have also affected the old brass and copper reliables. There can't be any product more prosaic than free-cutting brass rod; it is the cheapest of such commodities and at one time was the easiest to process—all one had to do was to extrude, draw to finish dimensions, and ship. In many cases this practice won't work today. Deep drilling, roll threading, knurling, staking, slotting, etc., have complicated the picture, but the latest efforts of the screw machine builders have laid this ghost to rest. We now hear of beta-free rod for close tolerances on deep-drilling applications. Similar grain structures, but not necessarily the same temper, are required for roll threading, knurling and staking or whenever extra ductility is needed. Along with the consideration of grain structure, it has been necessary to take advantage of the broad chemical composition range for free-cutting brass. Most suppliers divide the standard range into two parts, utilizing the lower copper range for the larger sizes that will normally be machined on the heavier, faster screw machines where chip breaking and clearing the tools are the most important considerations. This might be considered the rough, breakdown type of stock.

FOR the smaller diameters, specialization has been the watchword. Depending on specific needs, you can now obtain free-cutting brass rod with all-alpha, fine-grained structure or an alpha-beta fine-grained extruded structure, or possibly a combination of both. For certain applications you might need a coarse-grained, all-alpha structure. Lead dispersion and lead content are other variables that can and will be controlled to meet fabricating or end-use requirements.

IN the cold-heading industry, advantage is being taken of the wider selection of copper and copper alloys that is available today. The nickel silvers, phosphor bronzes, and silicon bronzes combine good ductility and high strength with excellent corrosion resistance. The whole range of common brasses has specific applications and can be tailored to various heading operations.

The research and development hopper is full of interesting new ideas and projects at Anaconda American Brass Co. It could be that we're working on something which would help solve one of your problems. Even though we don't have the complete answer, perhaps we could both reach a solution faster by pooling our efforts. Call your Anaconda representative and talk it over with him or write: Manager, Market Planning, Anaconda American Brass Company, Waterbury 20, Conn.

6050L

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COPPER – BRASS – BRONZE

NICKEL SILVER MILL PRODUCTS

Anaconda American Brass Company

til it is turned off; the second uses the same type of butterfly valve, but the valve snaps to the off position when the thumb is removed; and the third is a lever throttle type. The dead handle is constructed so that its position can be changed from 90 to 120 degrees from the throttle handle by rotating it. For close work, the handle can be removed entirely. Available speeds are 4500, 6000, and 8000 rpm. The tool weighs 7 1/2 pounds.

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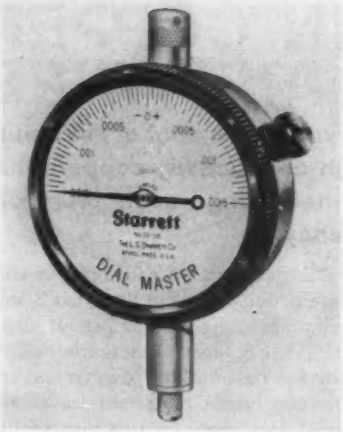


Starrett Introduces Eighty-Eight Tools

"Dial Master" indicator, one of eighty-eight new tools introduced at the recent Production Engineering Show in Chicago by the L. S. Starrett Co., Athol, Mass. This indicator has an accuracy of plus or minus 0.00001 inch. Included in the display of products exhibited was a new line of "Satin-Chrome" steel tapes; "Master Vernier" height gages and vernier calipers; many new micrometer calipers, inside micrometers, micrometer depth gages, and micrometer heads; Satin-Chrome bevel protractors, steel protractors, protractor - depth gages and combination protractor-square sets; superprecision dial indicators and dial bore gages; mechanics' tool chests; and many others. Typical of the tools now available with no-glare Satin-Chrome finish for easier reading and high resistance to corrosion and wear is the No. 359 series universal bevel protractor with vernier, ultrafine adjustment, and acute-angle attachment. Satin-Chrome finish on the protractor dial and vernier eliminates glare and makes reading easy in any light. Also available are steel protractors, protractor depth gages, and combination sets. These new tools are among the many important additions to the complete line of Starrett mechanics' hand measuring tools and precision instruments, steel tapes, steel rules, dial indicators and gages, hacksaws, hole saws, band saws, band knives, and precision ground die and flat stock displayed.

Circle 618 on Readers' Service Card

Capewell Band-Saw Dispenser

The Capewell Mfg. Co., Hartford, Conn., has recently introduced their Coilguard band-saw dispenser. It is made of high-impact plastic, designed to guarantee smooth easy dispensing and recoiling, and to provide complete band-saw protection both in transit and in the warehouse. The cut end of the band saw is readily available, yet does not protrude from the dispenser. Two-way labeling permits rapid identification when stacked either vertically or flat. Special nesting pins allow "shoulder to shoulder" stocking, and the hex shape prevents rolling. The through-center hole facilitates handling and mounting on pegs or pipes for dispensing.

Circle 619 on Readers' Service Card

THERE HAS ALWAYS BEEN
One Outstanding Name
IN FRESH OIL LUBRICATION...
MADISON-KIPP

Fresh Oil Lubrication is automatic, closely measured, constantly fed new oil under pressure for each friction surface to which it is applied.

Machine Tools, Compressors and special machines of all kinds have been kept in top condition for 20 or 30 years or more when equipped with one of 6 models of Madison-Kipp Lubricators.

The Model OL—one of the 6 Models of Madison-Kipp Lubricators.

kipp

MADISON-KIPP CORPORATION
203 WAUBESA STREET • MADISON 10, WIS., U.S.A.

Skilled in Die Casting Mechanics • Experienced in Lubrication Engineering • Originators of Really High Speed Air Tools

Table indexes clockwise, work fixtures counterclockwise for 6 holes 60° apart

Kingsbury machine drills and c'bores 135 steel forgings per hour gross

Problem: C'bore and drill six angular holes 60° apart in a forged steel gear.

Solution: Six drilling units with two-spindle heads are mounted on angular columns 60° apart on a circular base. An index table holds 12 work fixtures that do not turn with reference to any fixed point. As the table indexes clockwise 30°, each fixture indexes 30° counterclockwise. The work remains clamped as it indexes.

Each unit operates two tools downhill at a 27° angle. The first tool counterbores .1562 diam. at one station for an accurate start. The second drills .0397 diam. through at the next station. The operator changes parts in his fixture while the units perform their automatic cycles. Two tools operate at the same time on the part at the rear station.

Uniform Parts that Gage Maybe this seems simple. But it takes some doing to . . .

— build 12 fixtures that are exact duplicates, each one to hold the work firmly and accurately;

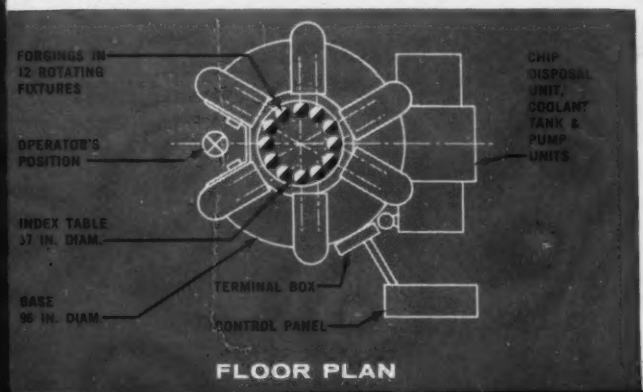
— remove backlash from the gears that index the fixtures;

— start angular holes straight and in exact position.

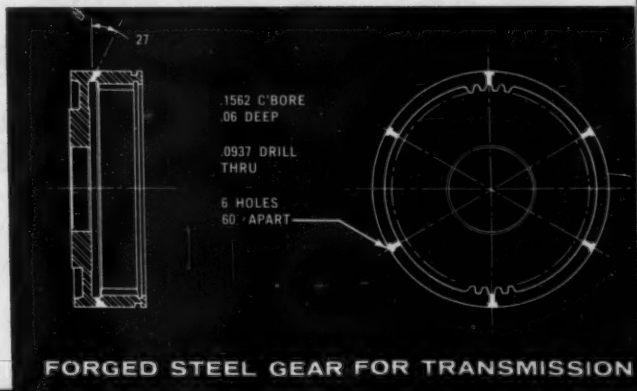
We specialize in solving such problems. Our machines have good basic design and accurate rugged construction to produce uniform parts that gage.

May we make you a proposal? You can then place one order for the entire machine and make us fully responsible that it meets your specifications. Kingsbury Machine Tool Corp., Keene, New Hampshire.

KINGSBURY MULTI-UNIT AUTOMATICS

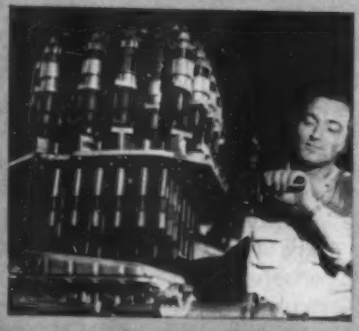

FORGINGS IN 12 ROTATING FIXTURES
OPERATOR'S POSITION
INDEX TABLE 37 IN. DIAM.
BASE 96 IN. DIAM.
TERMINAL BOX
CONTROL PANEL
CHIP DISPOSAL UNIT, COOLANT TANK & PUMP UNITS

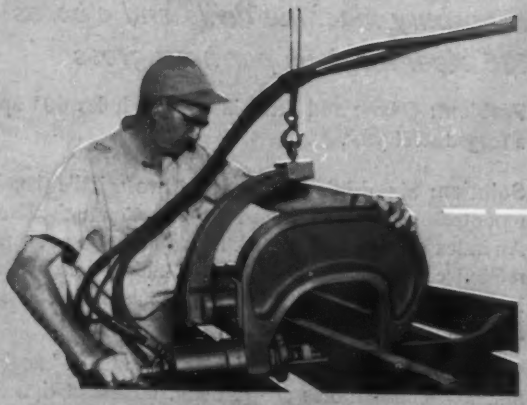
FLOOR PLAN



FORGED STEEL GEAR FOR TRANSMISSION

Fastener driving is our business...





UNIFORM... FAST... ACCURATE

SCREWDRIVERS AND NUTRUNNERS

Air and electric models with conventional or "one-shot" torque control clutches—reversible or non-reversible—selection of handle styles—for threaded fasteners from #4 to 5/8" diameter.

IMPACT WRENCHES

Air and electric models with conventional and torque control clutches—reversible—selection of handle styles—for threaded fasteners from 1/4" to 3/4" diameter.

MULTIPLE NUTRUNNERS

Air-operated units custom designed for simultaneous installation of two or more threaded fasteners—with direct drive or "one-shot" torque control clutch—for fasteners from #4 to 3/4" diameter.

COMPRESSION RIVETERS

Air, hydraulic and air-powered hydraulic models—portable or stationary—for ferrous or non-ferrous, solid or tubular rivets from 1/16" to 1 1/4" diameter.

NAIL DRIVERS

Air-operated models for 4 penny to 60 penny straight or threaded shank nails.

RIVETING HAMMERS

Air-operated models in wide variety of handle styles—for ferrous or non-ferrous rivets from 3/32" to 1 1/4" diameter.

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

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The Most for Your "Rockwell Testing" Dollar!

Clark Hardness Testers are *guaranteed* accurate for all "Rockwell Testing". Clark's exacting workmanship in the production of penetrators, testing blocks, anvils, and other accessories pays off in exceptional accuracy on the job. No wonder the low cost surprises our first-time customers. *Clark Instrument, Inc., 10204 Ford Road, Dearborn, Mich.*

FREE REFERENCE BOOK

All information about hardness testing in easy-to-read text with many illustrations. Just write "Send Book" on your letterhead. Description and prices for Clark Hardness Tester and free Hardness Conversion Chart also available on request.

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10204 FORD ROAD
DEARBORN, MICHIGAN

Missile-Age Accuracy

Circle this page number on card

Vibration-damping devices to be shown by Felters Co., Unisorb Division

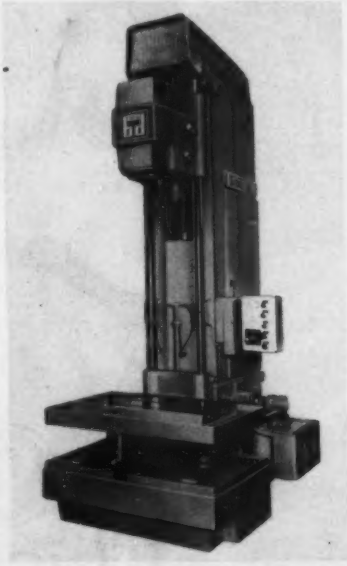
Unisorb Vibration-Damping Machine Mounts

The Unisorb Division of the Felters Co., Boston, Mass., exhibited new lines of machine mounts for vibration control at the Production Engineers Show in Chicago. Included was a new Type LR-200 series mount which employs a circular metal base and an insert of Unisorb vibration-damping material. These mounts have built-in leveling screws which can be locked in any position and are designed for use on motorized equipment that must be installed in quiet areas of a plant or office. Another development, the UL series, is a family of mounting plates for machines equipped with leveling screws. The UL and LR series are available in sizes that carry maximum loads from 800 to 7500 pounds. Unisorb material and mounts displayed are shown here.

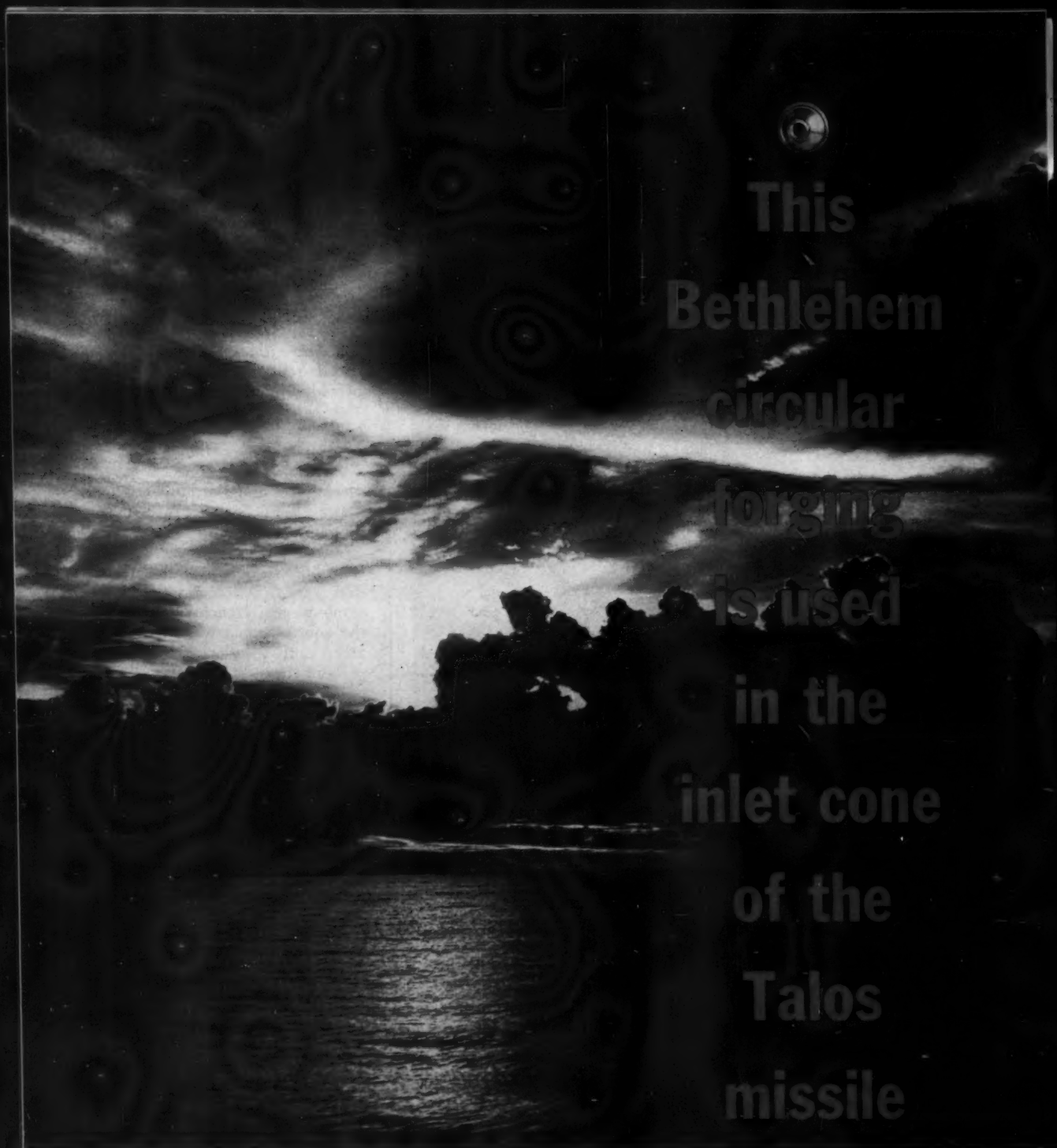
Circle 620 on Readers' Service Card

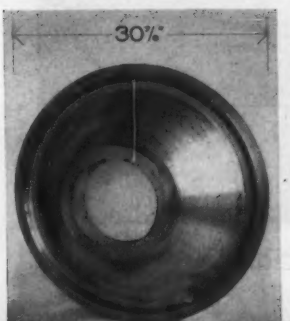
Barnes Vertical Honer for Large-Diameter Bores

New design features of the Model 3010 compact honing machine introduced by Barnes Drill Co., Rockford, Ill., save floor space, simplify operation, and reduce maintenance costs. This machine is available with 25-, 35-, 45-, or 60-inch spindle travel. It will hone bores up to 10 inches in diameter at maximum stroke, and larger diameter bores in shorter length strokes. Since no auxiliary electric panels are used, floor space is reduced and external conduit is kept to a minimum. All electric controls are built into the two side panels of the machine.



Barnes Drill Co.'s vertical honer for large-diameter bores





Other than using magnaflux-quality steel, we make circular forgings for highly critical missiles exactly the way we make *every* Bethlehem circular forging. Same manufacturing processes. Same quality control. The success of Bethlehem circular forgings in missile inlet cones, forward heads, and adapters is just one proof of quality. If you'd like the whole story, get in touch with our nearest sales office. Or write to us at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, Bethlehem, Pa. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

TRANSFER MACHINE BUILT BY BUHR MACHINE TOOL CO., ANN ARBOR, MICHIGAN

Automated GIANTS like this

REQUIRE STRONG HYDRAULIC *HEARTS* EVERY MINUTE OF THEIR WORKING LIFE

24 RACINE PUMPS *operate this 58 station 500-ton transfer machine*

The precisioned flow control of RACINE PUMPS assures the split-second timing and efficiency required to operate this complex Buhr Transfer Machine . . . custom-built for the completely automatic machining of 120 auto-cylinder heads hourly for a leading automotive manufacturer. Compact RACINE VALVES control feeds and reverse movements on all 323 operations performed by the machine. RACINE 4-WAY SOLENOIDS help one man operate this mechanical giant. Buhr has used RACINE PUMPS and Reservoir Units on custom-built machines for the automotive industry for over 10 years.

RACINE **Racine Hydraulics & Machinery, Inc.**
RACINE, WISCONSIN
HYDRAULICS DIVISION

Shoulder-height operating controls are removed from the area of coolant splash, and setup controls are protected by lock and key to avoid undesirable tampering after the setup has been made.

To change spindle speeds, the operator simply turns the two knobs on the right side of the head. One knob selects neutral-, low-, or high-speed ranges, and the other knob selects the specific speed in either the low- or high-speed range. Eight speeds are provided by a 10-hp motor with a V-belt drive. Stroke length is controlled by a dial mounted on the rear of the control panel arm.

A new electric hone expansion mechanism and BarnesdriL Plug-matic bore sizing mechanism maintain size consistency within tens of thousandths of an inch from bore to bore at high-production rates. When limitation of stone wear is reached, lights on the control panel warn the operator, and interlocking controls prevent the start of a new honing cycle until new stones have been inserted. Compensation for stone wear is also automatic.

A separate 10-hp motor powers the hydraulic reciprocation mechanism. To reduce maintenance problems, the hydraulic unit is located in the open at the back of the machine. The hydraulic controls and the coolant pump are also in the open at the lower right side of the machine. This machine can short-stroke at any point in the bore, and it is available with a dwell mechanism. A wide variety of fixtures and tables can be adapted to meet individual production requirements.

Circle 621 on Readers' Service Card

Speed Reducer

Compact, motorized speed reducer which provides output speeds of from 1.9 to 70 rpm

IT'S A FACT!

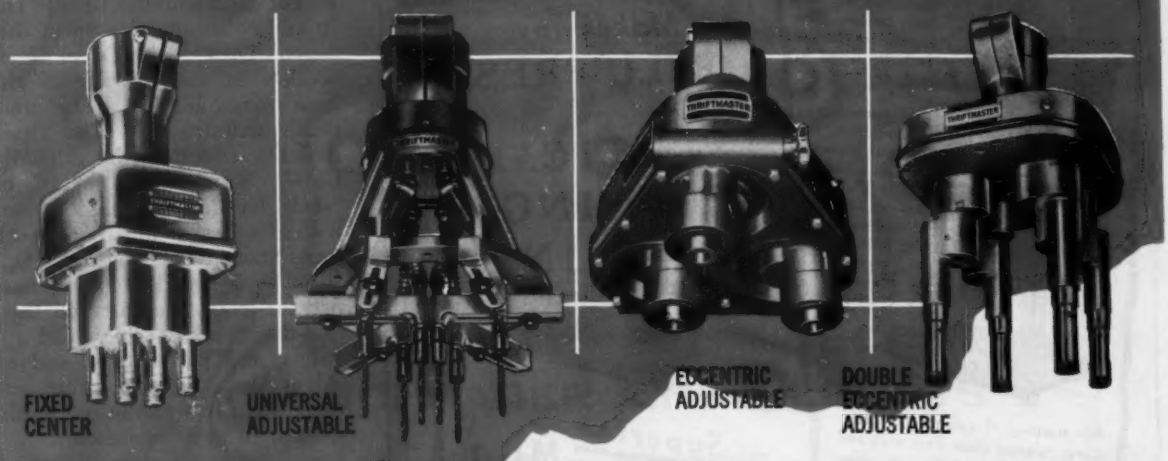
DRILLHEADS
ARE OBVIOUS.

Tremendous economies from the use of multiple-spindle drillheads are obvious. Drilling one hole at a time cannot be tolerated in this day of automation!

THOMSON
THRIFTMASTER
Drillheads
are your best Drillhead buy...

1. They are better built and cost no more (Full ball bearing construction, hardened gears, spindles and driver, and precision grinding!)
2. This means they last longer
3. This eliminates down time
4. This eliminates production losses
5. This drastically reduces drilling costs

THOMSON
THRIFTMASTER
Drillheads are designed and produced by engineers whose experience **in this specific field** dates back to 1923. This long accumulation of engineering technique and production "know-how" is reflected in our product—a **quality tool... solid, substantial and dependable!**



DRILL • TAP
REAM • BORE
COUNTER-BORE
COUNTER-SINK
FACE... with
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PRODUCTS CORPORATION

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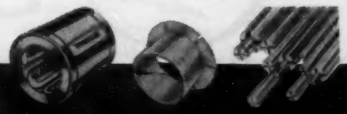
Also Makers of DORMAN AUTOMATIC REVERSE TAPPERS



Subsidiary of
THOMSON INDUSTRIES, INC.
makers of BALL BUSHINGS • NYLINERS • 60 Case Shafting

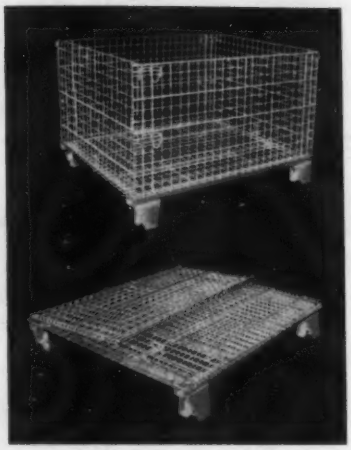
For more data circle this page number on card at back of book

available from distributors for the Boston Gear Works, Quincy, Mass. Called the MW109 Ratiomotor, this unit offers a broad selection of low output speeds. It is a worm-geared, horizontal, parallel-drive, standard stock model, powered by specially designed 1/20- or 0.035-hp motors.

Circle 622 on Readers' Service Card

Collapsible Wire Mesh Box

Wire mesh box which folds to pallet height for easy storage now available in capacities of either 2000 or 4000 pounds from the Republic Steel Corporation, Canton, Ohio. These boxes are designed for use on production lines for shipping or warehouse storage. Termed "Loadtainers" by the company, they are fabricated from 2-gage, 70,000-psi, minimum tensile strength wire, welded to give 2- by 2-inch mesh. The sides are helixed to the ends at opposite corners for easy folding, and also to the deck section for extra strength. The deck uses 7/8- by 1 1/2-inch hot-rolled steel for the



end channels and 1/4- by 1 1/2-inch bar stock spaced across the bottom for additional support. Offered in either the Atlas or Titan series, all boxes have a basic capacity of 2000 pounds. This may be increased to 4000 pounds by welding two vertical reinforcing wires to each corner, and two horizontal wires to each end and side. On both Atlas and Titan Loadtainers, heavy-duty, nonslip locks are provided so that sides cannot accidentally open. The Atlas has structural corners that resist shock. The steel legs, welded to each corner of the base frame, are said to be practically indestructible. The Titan, differing from the Atlas primarily in leg design, uses "skids" or "sleds" for ultimate stability. Even with this design difference, both types stack interchangeably. Optional equipment includes crane eyes or loops, identification tags, half-drop end or side, load dividers, and partial drop end or sides. Also, available as an optional item is a galvanized finish. Aluminum paint is standard.

Circle 623 on Readers' Service Card

Close-Coupled Hydraulic Pump Motor

Hydraulic pump motor Type H-7, of close-coupled design, introduced by U. S. Electrical Motors Inc., Los Angeles, Calif. Rugged, heavy-duty, compact, this H-7 motor has a corrosion-resistant, cast-iron frame, with a unique mounting bracket. The bracket is designed to eliminate mounting base and complicated adapters

SUPERIOR MAKES HONING POSSIBLE AT LOWER COST

MODEL VH SUPERIOR HONING HEAD

Adaptable to most drill presses. Designed for honing work too heavy to hold on machine, and to have all the convenience of operation of Superior Honing Machines. Range 1/8" to 3". Size dial on bottom of head permits the increasing or decreasing of size while in operation.

No stopping of spindle necessary. Lever releases stone from work and expands stone to same size under spring pressure on next part. Only adjustment necessary to duplicate size is for stone wear.

Stocked in all principal cities.

Send for details and prices.

Makes any DRILL PRESS a VERTICAL HONING MACHINE

Superior MD-1 Mandrel Driver

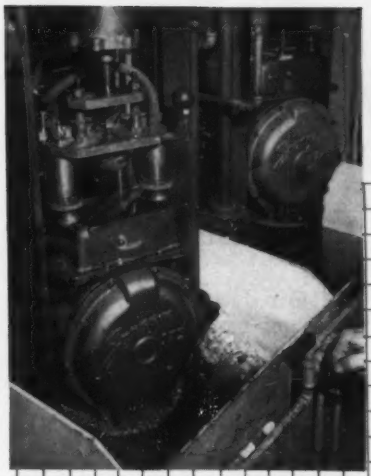
Rapid, economical hole finishing and sizing with .0001 accuracy. Ideal for die work, bushings, dowel pin holes.

Only the stones contact work piece, assuring long life and preventing marks on honed surfaces.

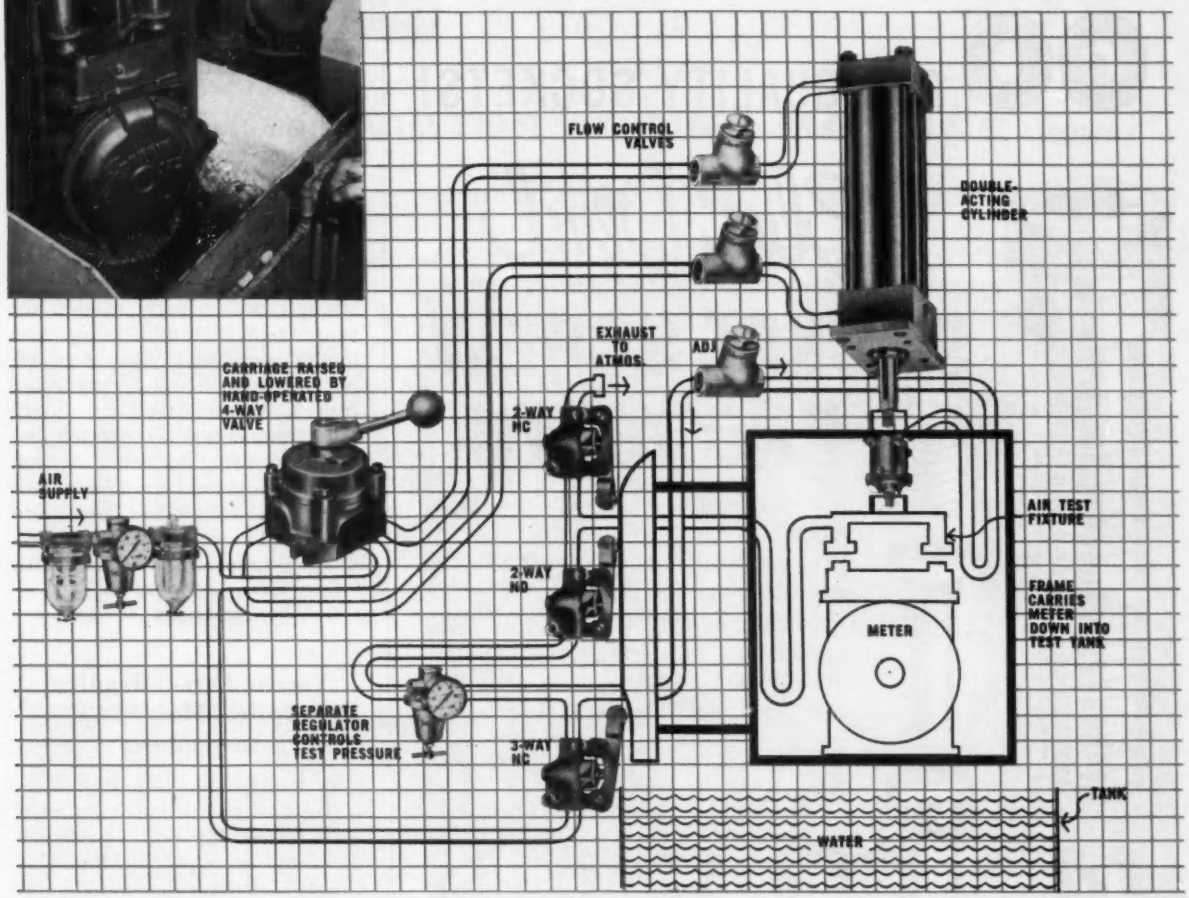
Permanent type mandrel sizes; .120 to 3.000; available in No. 2, 3 or 4 morse tapers.

SUPERIOR HONE CORPORATION

1023 Elreno Street • Elkhart, Indiana



Here's how one company tests its products with air. This air circuit of Schrader Products at the Sprague Meter Company in Bridgeport, Connecticut, automatically clamps meter ports airtight, lowers meter into water, and fills it to test pressure. Operator looks for telltale bubbles from leaks, then presses lever to raise meter automatically. Says the Plant Manager: "This used to be a slow, arduous process. Now a meter's in the water, under pressure, in less than a second."



MANUFACTURER SETS UP CRITICAL TEST IN LESS THAN ONE SECOND— WITH SCHRADER AIR PRODUCTS

As products grow more complex and precise, many manufacturers are *simplifying* their operations—with air cylinders, valves, fittings and simple schematic planning. They're installing their own circuits, as this manufacturer did, or letting Schrader experts help. For example, Schrader Air Products can inspect, test, assemble, package—do work faster, more accurately—save effort and money.

Never forget air can make almost any motion human hands can—push, pull, hold, position, or move repetitively. And air doesn't get tired—has more powerful muscles. Maintenance? Almost nil.

Take full advantage of your air power by automating with Schrader—the most complete line of Air Cylinders, Valves, and Accessories. Schrader engineers have experience and know how to help you cut your operating costs.

Select your automating equipment from the full Schrader line. Your Schrader distributor can help you pinpoint what you need. For more data, write:

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454 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

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STOP FASTENING FUMBLES—
GO FOR QUALITY SOCKETS!

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SOCKET SCREW PRODUCTS

There's no point in using almost-as-good socket screws . . . not when you can get finer Blue Devil Socket Screw Products. A complete line for every application, in a wide range of sizes and styles. Your Blue Devil distributor can give you immediate delivery in any quantity.

Actual cross-section diagram shows how cold forming of Blue Devil Socket head insures unimpaired fiber continuity.

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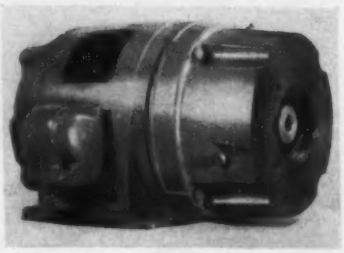
MEMBER ASMMA



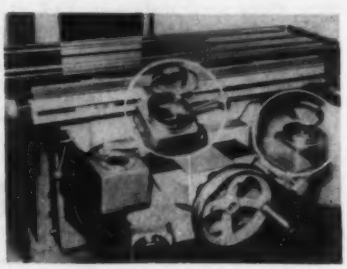
and to reduce over-all length of the pump-motor unit. Concentric mounting is assured through the use of exclusive U. S. castings normalized to prevent warping of precision machined parts. The cast-iron frame also provides the strength and rigidity needed for support of hydraulic pump and motor. Additional couplings are not needed; a rigid, precision, splined coupling allows direct pump connection. Completely enclosed housing protects against hazard of exposed couplings. Both single- and double-end models are available to fit all standard hydraulic pumps. Made in sizes with ratings from 3/4 to 50 hp.

Circle 624 on Readers' Service Card

Vernac Direct-Reading Optical Measuring Instrument

Easy-to-use, direct-reading Vernac optical measuring instrument with no moving parts, made by the Simpson Optical Mfg. Co., Chicago, Ill. This device indicates the longitudinal, lateral, or vertical position of any machine tool table. It can be read to an accuracy of 0.0001 inch without interpolation by means of a scale affixed to the machine table. Designed for incorporation both on new and existing equipment, the Vernac eliminates inaccuracies due to wear and stretch of table screws and damaged end rods and gage-blocks.

Circle 625 on Readers' Service Card

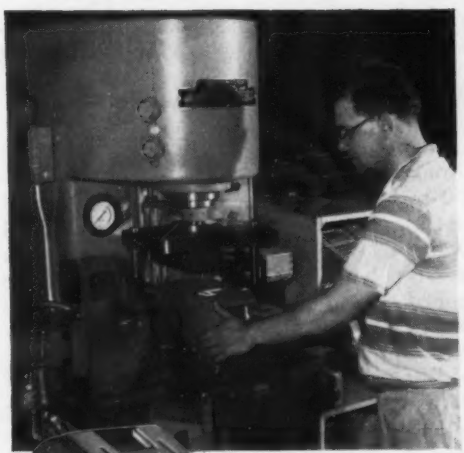


Denison, Denison HydrOILics, and Multipress are registered trademarks of Denison Eng. Div., ABSCO

DENISON HydrOILics

16 different **VICTOR ADDING MACHINE** cases perforated without tooling changes, demonstrates **DENISON** Multipress...

VERSATILITY



PERFORATING *16 different plastic case designs without tooling changes, this 8-ton Denison Multipress reduces inventory requirements and speeds production for Victor Adding Machine Company, Chicago. Typical case after punching, shown at left.*

SHARPLY REDUCED inventory requirements, no scrap loss and production line versatility are just 3 of the important advantages gained with this Denison hydraulic Multipress at Victor Adding Machine Company.

Previously, stocks of at least 6 different basic plastic shells had to be maintained to produce cases for 16 different models in the Victor Champion line.

Now, with an 8-ton Multipress equipped with special tooling and controls which enable the operator to select a variety of punching combinations automatically, only *two* basic shells are required in stock. And *all* of the 16 different case design variations are perforated on the Multipress *with no change of tooling*. And the right shell is always on the assembly line at the right time.

Smooth, controlled hydraulic power perforates the "Cycolac" plastic, without charring or discoloring. Holes are clean and smooth . . . there's no scrap loss . . . punch life is significantly longer. This operation at Victor Adding Machine is another case-in-point showing how Multipress versatility and usefulness can save time and money in *your* plant. Call in the nearby Denison Production Specialist to discuss how a **M**ultipress **A**nalysis **P**rogram can start to **MAP** production savings for you now.

DENISON ENGINEERING DIVISION
American Brake Shoe Company
1152 Dublin Road • Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON
HYDRAULIC MULTIPRESS

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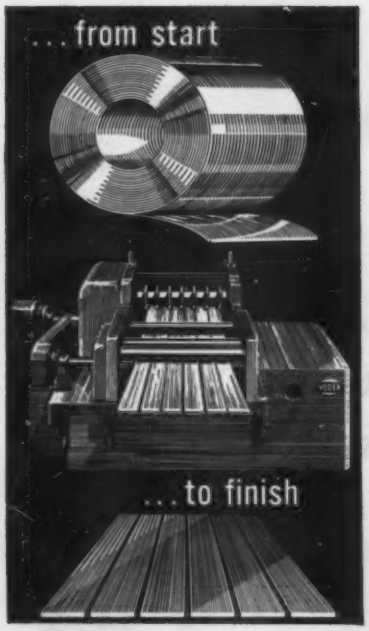


YODER ROTARY SLITTERS

If your slitting requirements call for coil widths from 12" to 60", in gauges from .015" to .250", the economy of purchasing Yoder Slitting Machinery can be yours. Operating a Yoder Slitting Line only one eight-hour shift per week, for example, could easily produce 35 tons of slit strands per week... or 1,820 tons every 52 weeks. At a slitting cost saving of only ½¢ per pound, the annual savings would amount to $18,200.

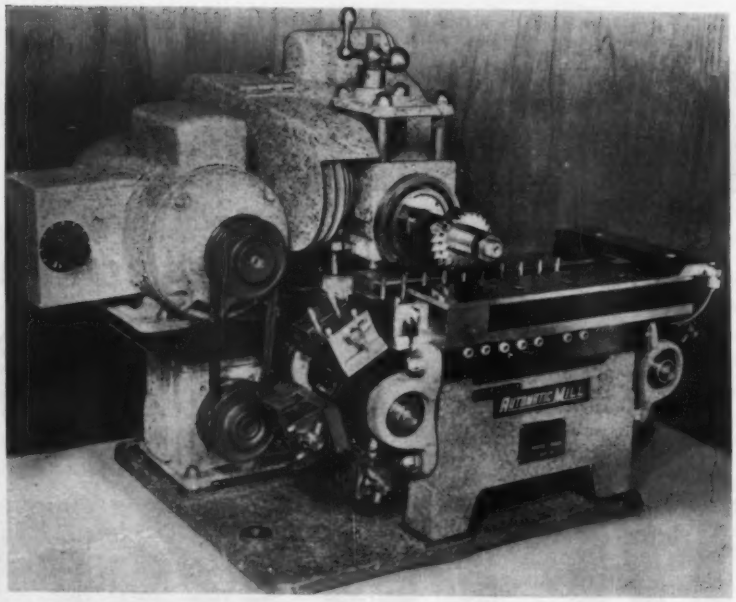
Additional savings can be realized through lowered inventory of mill-width coils—less waiting for delivery of special slit widths. Also, customer satisfaction will increase as you achieve faster completion and delivery of finished products.

At your request a Yoder sales engineer will study your plant operation to determine what equipment would most economically... and profitably... serve you, whether it be standard components or a completely specialized and engineered line.

Send for Yoder's illustrated text on slitting operations and equipment. It describes methods, time studies, operating cycles, material handling, and gives full specifications.

THE YODER COMPANY
5504 Walworth Avenue • Cleveland 2, Ohio

ENGINEERING YODER MANUFACTURING ROTARY SLITTING LINES



AutomaticMILL introduced at Machine Tool Show by the Baird Machine Co.

Automatic Milling Machine

A recently developed automatic milling machine capable of production milling rates as high as 6000 parts per hour was exhibited in operation at the Machine Tool Exposition in Chicago by the Baird Machine Co., Stratford, Conn. Designated the Baird AutomaticMILL, this machine is capable of maintaining tolerances of plus or minus 0.001 inch in the milling of precision electronic components as small as 0.050 by 1/4 inch, as well as tool bits as large as 1 inch square. In operation, the chain drive continuously moves as the parts to be milled are inserted by hand or automatically hopper fed into the jaw cavities. The jaws are attached to the carrying bases which are accurately located in the ways by heavy spring-loaded bearings.

Individual self-contained jaws apply pressures from 50 pounds up to 1/2 ton per jaw, firmly holding the parts in the jaw cavities as they pass beneath the cutter and are milled. Jaws open and close automatically while in continuous operation.

The carrying bases continue beyond the hardened ways, allowing internal springs to open the jaw cavities and release the machined parts. The chain drive carries the bases beneath the unit to the starting position where built-in air wipers remove all chips and dirt from the bases and jaws prior to re-entry into the ways where the cycle is continued. The AutomaticMILL may be attached to the end of any milling machine. A low-cost self-contained unit is available with a built-in milling head.

Circle 626 on Readers' Service Card

Fastite Nut

Combination nut and helical spring washer permanently held together but free to rotate when pressure is applied. This Fastite nut, as it is called, is a recent development of the Reliance Division, Eaton Mfg. Co., Massillon, Ohio. An outstanding feature of the nut is the incorporation of the helical spring washer which is de-

tailored...

For long or short runs on large bearings

Whether you are grinding a range of bearing races involving one shape in various sizes, or parts which involve a complete change in configuration — for example, from roller bearings to ball tracks — the versatility and tailored tooling of Bryant Internal Grinders assure you of record production rates and consistently high quality.

Contact your nearest Bryant or Ex-Cell-O sales representative and let him show you how Bryant Internal Grinders can improve your production of varied workparts.

BRYANT Chucking Grinder Co.

20 Clinton Street, Springfield, Vermont

Offices: Springfield, N. J. • Cleveland • Detroit • Indianapolis • Chicago

Precision Internal Grinders, Spindles, Special Machinery and Components

For more data circle this page number on card at back of book

signed to give a high reactive range and spring pressure. These characteristics are said to considerably reduce the incidence of failure of bolted assemblies due to bolt stretch, thread creep, and linear dimensional changes caused by rapid thermal expansion or contraction.

Circle 627 on Readers' Service Card

Directional Control Valve

Large-capacity, three-way directional control valve added to the

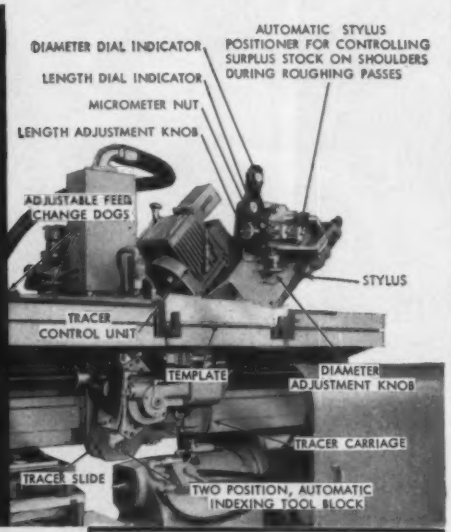
A series line of solenoid valves manufactured by the Skinner Electric Valve Division, New Britain, Conn. Available in 3/32-, 1/8-, and 5/32-inch orifice sizes for directional control of such media as air, oil, and inert gases, and can be used on vacuum lines down to 5 microns. Compact and light in weight, the valves can be mounted in any position directly to the line and operate on pressure differentials up to 250 psi, depending on orifice size desired.

Circle 628 on Readers' Service Card

STRAIGHT LINE DIAMETER AND SHOULDER ADJUSTMENT FOR TRACER TOOLS

STYLUS DIAMETER ADJUSTMENT IS MADE ON 90° ANGLE TO CENTER LINE

STYLUS LENGTH ADJUSTMENT IS MADE PARALLEL TO CENTER LINE



When using the Seneca Falls Model Q Lathe, diameter and shoulder length accuracy is controlled by the stylus which is adjusted on compound slides whose displacements are indicated by dial gages. Slide adjustment knobs are rotated so that dials indicate the desired amount of stock removal, after which they are again set at zero. Both diametral and length adjustments are made by the "straight line" method. .each independent of the other. The dial gages also provide visual indication of tool wear and permit resetting of the stylus to zero position when the tool insert is indexed or changed for a fresh cutting edge.

Another feature of this stylus adjusting mechanism is that the amount of surplus stock left on the shoulders during the roughing passes may be automatically controlled. The illustration shows the micrometer nut which may be preset for limiting surplus shoulder stock on the finishing pass. The shifting of the stylus between the roughing and finishing passes is entirely automatic. Write for Bulletin No. Q-59.

model Q tracer lathe features

- Numerical control simplifies changeover.
- Multiple tools rough and tracer tools finish turn in one automatic cycle.
- Mechanical feed to all carriages.
- Templates clear of chip area.
- Easy to load and unload.
- Straight line diameter adjustment for tracer tools.
- Four speed headstock available with automatic speed change.
- Feed rate can change during cutting cycle.

SENECA FALLS MACHINE — ENGINEERED FOR PROFIT

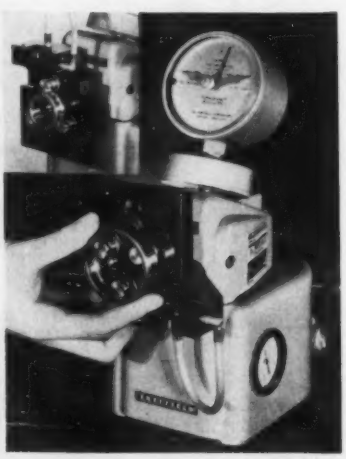
DO tell us your troubles. If turning, centering or automation are involved, most likely we can do more than sympathize

SENECA FALLS, MACHINE CO.
SENECA FALLS, N. Y.

Gage for Measuring Inner and Outer Race Diameters

"Little Champ" Dialaire three-point inner and outer race diameter gage for use in the manufacture and servicing of ball bearings, announced by the Sheffield Corporation, Dayton, Ohio. This instrument measures both inner and outer races. The large view shows the gage checking an outer race and the insert an inner race. Quick-change tooling is used to accommodate bearing sizes in the bore range of 8 to 50 millimeters. This tooling is identical in design with existing Precisionaire bearing matching gage tooling which can be used interchangeably on the gage. Of small size—only 6 inches wide by 7 inches deep—the gage is especially adapted for use at the grinding machine. It provides ample air gage amplification for close-tolerance grinding. Each division on the Dialaire gage equals 0.1 inch.

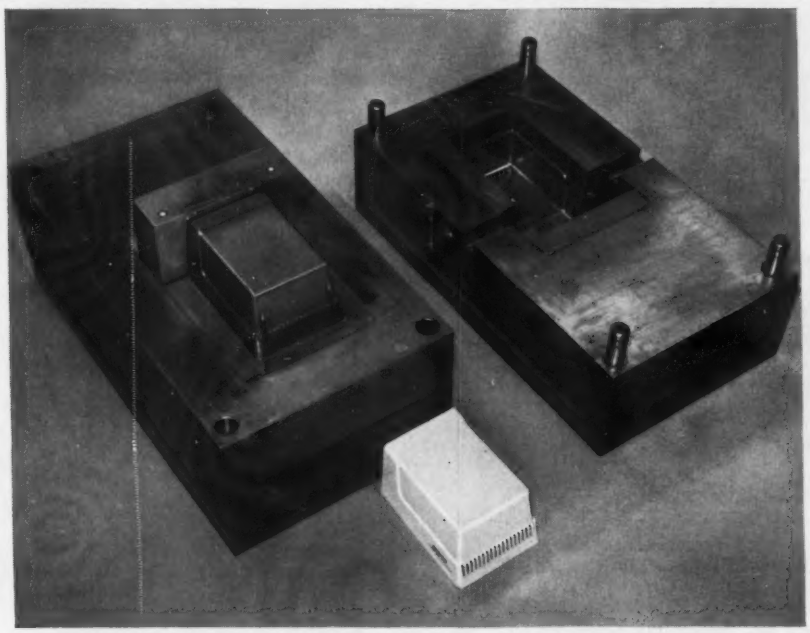
Circle 629 on Readers' Service Card



Tool Steel Topics

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.



LUSTRE-DIE does smooth job in molding can-opener housing

Bethlehem Lustre-Die tool steel, which is furnished pre-heat-treated in bars, recently turned out a top-quality molding of high-impact polystyrene at Cepco Plasties Co., St. Louis. The plastic-injection mold, made by Lambert Engineering Co., produced a sturdy, attractive can-opener housing for Swing-A-Way Manufacturing Company.

Here are the reasons why Lustre-Die made such a hit: 1. It saved time, because no heat-treatment was required. 2. It was easier to machine than other pre-hardened grades which were previously used. 3. It polished beautifully, and imparted a high sheen to the finished part.

An electric-furnace steel with a well-balanced basic analysis, Lustre-Die is ideal for working with plastic because it takes a glossy polish. This tool steel also has something extra: a special alloy fortification which further increases its depth of hardenability and enhances its mechanical properties. It is heat-treated by oil-quenching and tempering at the mill, and is furnished ready for machining and polishing. Careful manufacture and quality control insure its freedom from porosity.

You can take our word for it—Lustre-Die is just what you need for a good plastic-molding job. For full details, and prompt delivery, get in touch with your Bethlehem tool steel distributor.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Straighten tools while they are hot

Though seldom recognized or appreciated, straightening is an essential part of the quench and temper hardening operation on long, slender tools. The correction of warpage which occurs either in heating tools to the quenching temperature, or from stresses generated in the quench, must be done during heat-treatment. Only minor straightening can be done on hardened tools at room temperature after the hardening operation is complete.

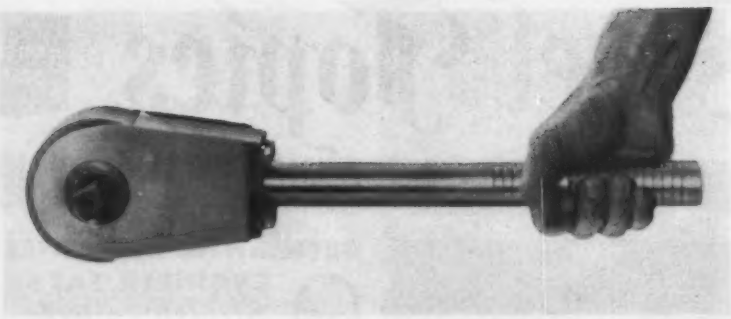
For example, the major straightening on a long rectangular shear blade must be done during quenching. The heat-treater learns by experience at what point the quench can be interrupted so that straightening can be performed. This point varies with the grade of tool steel, and the size and shape of the shear blade. Straightening usually is performed by bending the tool slightly on a press (so-called gag straightening).

Small amounts of additional straightening can be accomplished when the tool is at the tempering temperature. Or, if necessary, this can be done by reheating to a point just below the final tempering temperature.

Minor mechanical adjustments in the final assembly of tools and components are often made by peening the concave surfaces with a hand hammer. This should be done cautiously to avoid spalling or cracking. However, it is preferable to straightening by cold-bending.

New Booklet on Oil- and Air-Hardening Grades

We have a new illustrated booklet on oil- and air-hardening tool steels. It presents essential data about the BTR, Air-4, Lehigh H, and A-H5 grades. For your copy, write to Publications Dept., Bethlehem Steel Co., Bethlehem, Pa. Ask for Booklet No. 532.



Manual Impact Wrench

A portable wrench which multiplies the torque applied to its handle over 1500 per cent, yet requires no auxiliary equipment or power connections, is being made by Curtiss-Wright Corporation's Marquette Division, Cleveland, Ohio. Inside the handle of the "Swench" is a strong spring in which power is built up and then released as torsional impact every time the handle is advanced slightly more than 30 degrees. Since the impacts represent constant energy, bolt tension can be precisely controlled by an audible click announcing each impact. To loosen a frozen nut, the square on the opposite face of the wrench is engaged with the drive socket. Three sizes are available, accommodating bolt diameters from 1/2 to 1 1/4 inches, 3/4 to 1 3/4 inches, and 1 1/4 to 2 1/2 inches, respectively.

Circle 630 on Readers' Service Card

PUSH BUTTON *Speed Selection*

from **to** **in seconds**

or to *any* intermediate speed, *instantly*

Just push a button and watch the large tachometer dial on the headstock!

It's that easy!

The work is done by a motor driven speed changer. It accelerates or slows the lathe to any desired speed in seconds. With a 10:1 ratio, this new variable drive makes it easy to select from a wide range of speeds—200 to 2000 rpm in direct drive and 40 to 300 rpm in back gear.

Maximum stability and smooth power transmission are assured because the drive unit is oversized. All pulleys and shafts are fully supported (eight bearings). Double V-belts throughout the drive eliminate slippage and deliver full power to the spindle. Because of this rigidity and extra pulling power, this lathe will take heavy cuts at all speeds and precision finish cuts at high speeds.

It is a precision lathe, moderate in price, with the versatility for toolroom, production or second operation jobs.

SHELDON *Variable Speed* **PRECISION LATHES**

Illustrated WM56P 13" Swing- 34" Centers

Write for

"Variable Speed" Circular and General Catalog showing . . .

• 10", 11", 13" and 15" SHELDON Precision Lathes (Bench, Pedestal and Cabinet types)

• 13" and 15" SEBASTIAN Geared Head Lathes

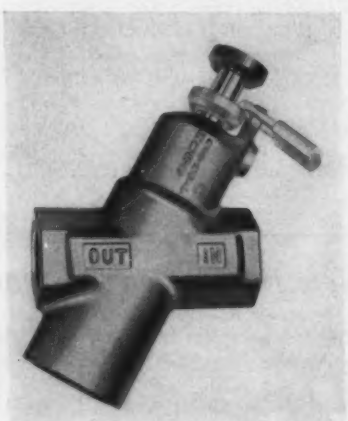
• SHELDON Milling Machines

• SHELDON Back Geared Shapers

SHELDON MACHINE CO., INC.
4246 N. Knox Ave. • Chicago 41, ILL.

Ross Air Valve with Safety Lockout

Valve designed to increase safety during repair, maintenance, and shutdown periods on machines using compressed air power announced by Ross Operating Valve Co., Detroit, Mich. This L-O-X (lockout and exhaust) valve is installed in the air-supply line leading to the machine, upstream of any operating valve, and normally the air flow is right through it. When L-O-X is shifted, air to the machine is shut off and the air downstream is exhausted to the atmosphere. The valve can



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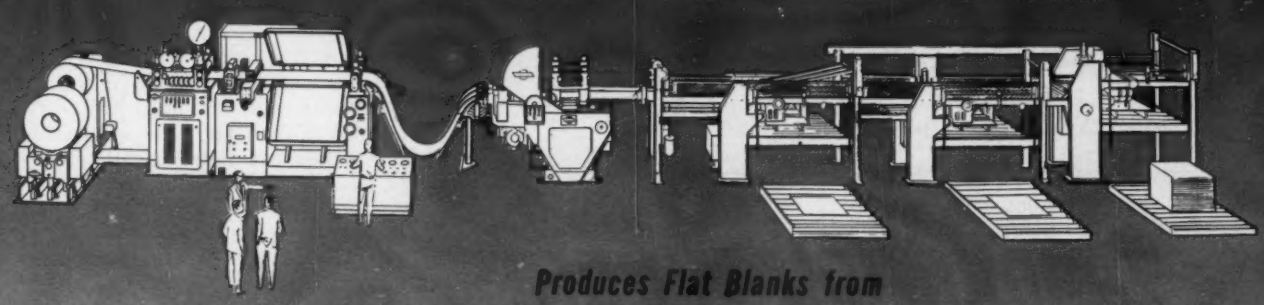
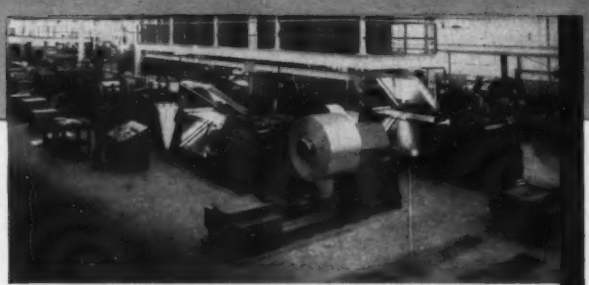
engineers, integrates and guarantees this

HIGH SPEED SHEETING LINE



Produces Flat Blanks from Coil Stock .0055" to .020" ACCURATELY—within .007" in Length and Squareness FAST—75 three-foot blanks per minute!

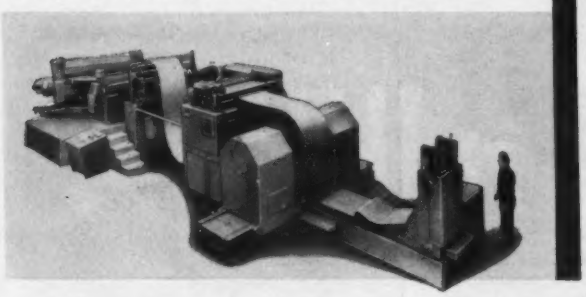


TYPICAL LITTELL TINPLATE SHEETING LINES

At Crown Cork & Seal Company, these lines convert coil stock into flat sheeted tinplate, cut square, and to accurate lengths, in one continuous, automatic operation.

TYPICAL LITTELL TRAPEZOID SHEETING LINE

For The Budd Company, this Littell Trapezoid Sheeting Line converts heavier coil stock into custom cut rectangular, parallelogram and trapezoidal flat blanks for subsequent stamping and drawing operations.



The accuracy, the speed, and the low cost production record of this Littell line has made it standard equipment with the most exacting metalworking manufacturers. One company alone has 24 of these lines producing flat blanks. In every instance where the line has gone into service, the user has ordered more!

Littell engineers *and guarantees* the five complex individual units in the line to operate as one. Each unit is integrated and synchronized, one with the other, to produce flat blanks from mill coils faster, more accurately and at lower cost than has been possible before. Littell *guarantees* a tolerance of ±.007" in length and squareness in producing blanks up to 36" long at the rate of 75 blanks per minute. You get this accuracy on paper-thin .0055" tinplate or steel stock .020" thick. Operation is automatic, controlled by one man. Imperfect blanks are automatically rejected by electronic controls. Can manufacturers report the Littell line's scroll cutting efficiency saves six percent in material.

Whether you work thick or thin stock, a Littell Sheeting Line can work to your advantage and quickly pay for itself. Let's talk it over. 'Phone or write.

COILY SAYS:
"When you call or write, be sure you ask for Bulletin G-10."

F. J. LITTELL MACHINE CO.

4159 N. Ravenswood Avenue, Chicago 13, Illinois
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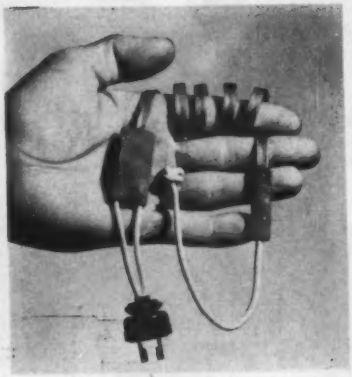
District Offices: Detroit and Cleveland. Dealers in Principal Cities

ROLL FEEDS • SHEETING LINES • STRAIGHTENING AND FEEDING MACHINES • REELS AND CRADLES FOR COIL STOCK

then be locked in the closed position with a padlock. It has only one moving part; is detented in the open position and designed for a minimum pressure drop. Made in four sizes for 3/8- to 1-inch pipe. The area through the valve is greater than the interior of the standard pipe for which it is tapped.

Circle 631 on Readers' Service Card



Glas-Col Heating Tape

Double-element heating tape 1/4 inch wide, designed for laboratory heating of extremely small objects, announced by Glas-Col Apparatus Co., Terre Haute, Ind. This tape employs the same paralleled heating element design as the company's 1/2- and 1-inch heating tapes which have both leads at the same end of the tape for making easier and safer connections. Heating elements consist of parallel Nichrome ribbons. Each ribbon is covered with glass braid which serves as insulation between the ribbons and is impregnated with a tough, pliable silicone rubber. The silicone coating makes the tapes completely water and weatherproof. Uniform heating patterns on the smallest of objects up to 480 degrees F. are assured by the double-element heating tape. The tape is only 1/16 inch thick, flexible and durable, and can be easily wrapped around objects as small as 3/8 inch in diameter without damage. It is available in lengths of 4, 6, 8, and 10 feet. Special lengths can be furnished.

Circle 632 on Readers' Service Card

PRODUCTION-MINDED and PRECISE

+

When the name plate states "It's a HAMILTON TOOL," you can "Use it with confidence."

The NEW Hamilton-Varimatic,® a radial type drilling machine with super sensitive feed, produces small holes (to 5/16" dia.) with instrument precision — at production speeds.

Spindle speeds are infinitely variable. A simple adjustment of the graduated hand wheel selects any desired spindle speed between 840 and 2700 R.P.M., or between 2900 and 9300 R.P.M.

+

It is available with conventional base and work table, or with "toolroom base" and compound table as shown at the left. Also offered in multiple spindle designs.

2959

GET THIS

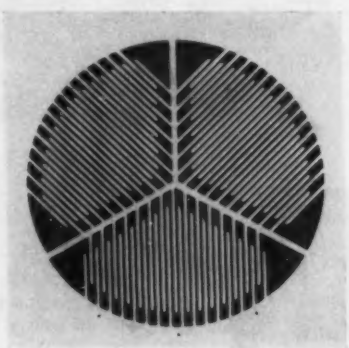
Bulletin No. 2959 provides complete description, includes sectional drawing, lists features, gives specifications. It's FREE. Write for it now!

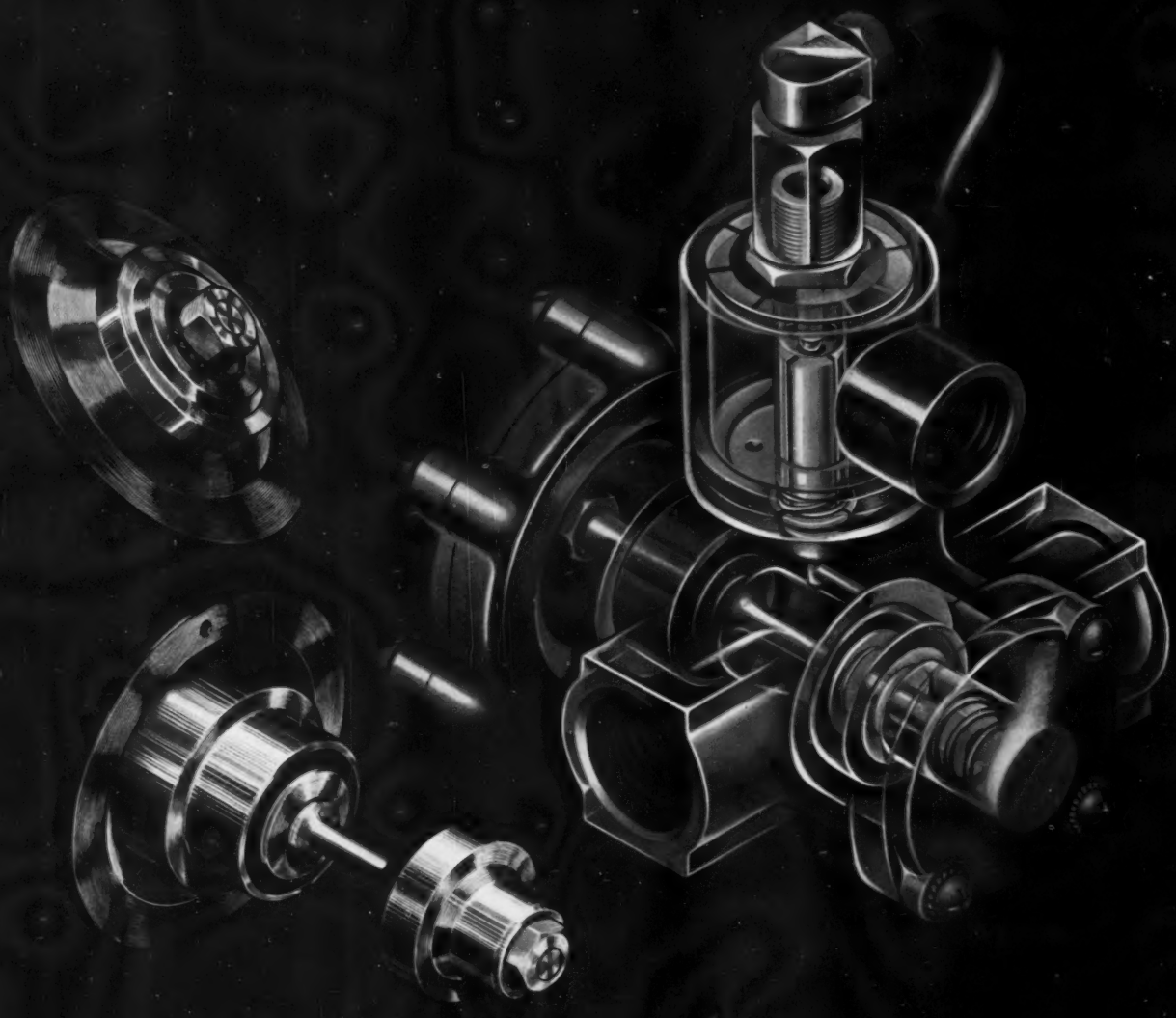
THE HAMILTON TOOL COMPANY

834 SOUTH NINTH STREET HAMILTON, OHIO

Rosette Strain Gage

Single-plane rosette strain gage announced by the research and development laboratory of the Electronics & Instrumentation Division of Baldwin-Lima-Hamilton Corporation, Waltham, Mass. The special design of this unique strain gage is said to offer several advantages. Being very thin, it minimizes errors encountered in bending measurements. It has a maximum of sensing elements in a given area, thus giving measurements closer to a point than the regular single-plane rosette. The gages are made from materials specifically selected and





SKINNER *2-way and 3-way Solenoid Valves*

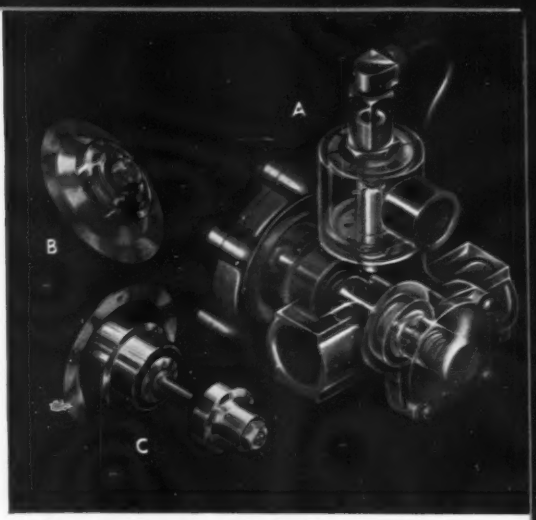
for high flow, heavy-duty industrial use

Skinner combines unique diaphragm assembly and V5 solenoid operator in new L Series valves

Skinner has now combined its famous V5 solenoid operator with a unique diaphragm assembly in a new line of two-way and three-way valves—the versatile L Series.

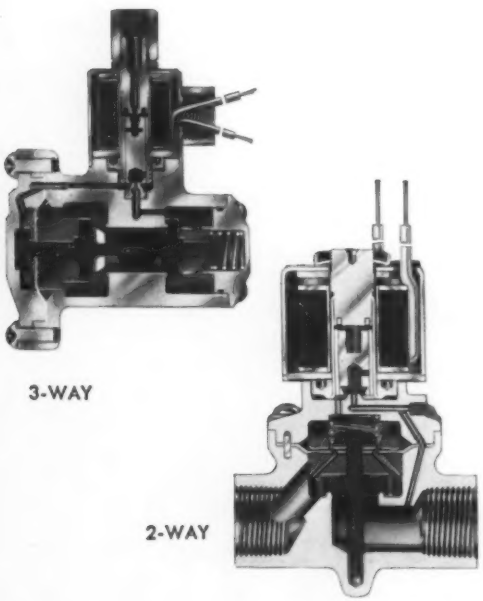
Unusually long life is assured by this new diaphragm assembly. The 3-way diaphragm consists of two tough laminates of nylon fabric coated with a Buna-N rubber separated by a thin Teflon disk. The assembly is virtually 100% supported in the open and closed positions with only a very small area exposed to pressure differential during operation. Life tests show that this type of diaphragm far out-performs all others tested.

The two-way diaphragm and spindle assembly supports a seal retainer and soft, synthetic seal which provides bubbletight sealing of the main orifice. This seal fits on a shoulder which extends beyond the seat and helps to cushion the closing motion—thus minimizing water-hammer.



A—Transparent view of normally closed 3-way solenoid valve
B—Front view of diaphragm assembly
C—Spindle seal retainer and diaphragm assembly

Low cost 2-way and 3-way valves to meet your high flow industrial requirements



Cutaway views of 2-way and 3-way valves showing how the unique diaphragm assembly and solenoid operator are combined in these new valves.

Skinner L Series solenoid valves feature forged naval brass bodies, stainless steel and brass internal parts. They are available normally closed, normally open and directional control in standard and explosion-proof construction.

In addition to the many exclusive features, these Skinner valves are low in price, and with one model—a 2-way normally closed valve—available at especially low budget cost.

All 3-way and 2-way normally open valves are supplied with a piped exhaust return. For catalogs and complete information, contact a Skinner Distributor listed in the Yellow Pages or write us at the address below.

SKINNER L SERIES SPECIFICATIONS

	TWO-WAY	THREE-WAY
Pipe Sizes, NPTF	⅜"*, ½", ¾", 1"	⅛", ½", ¾"
Orifice Sizes	½", ¾", 1"	⅜", ½", ¾"
Operating Pressure Differential — Minimum	5 PSI	5 PSI (⅜" 10 PSI)
Operating Pressure Differential — Maximum	150 PSI	150 PSI
Position	Normally closed, Normally open	Normally closed, Normally open, Directional control
Leakage	Bubbletight	Bubbletight
Temperature Range (Ambient and Media)	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F

*has ½" orifice

When you specify solenoid valves, specify Skinner.

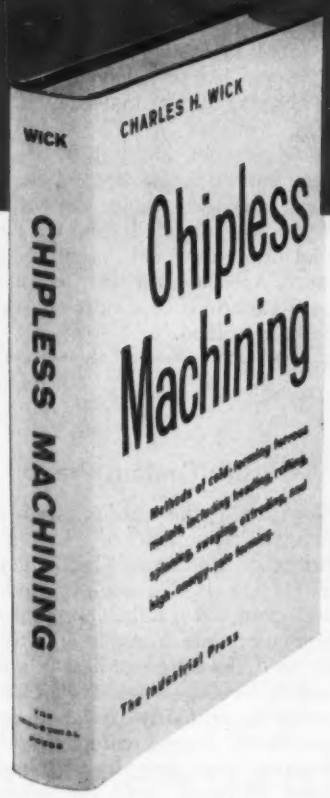
Skinner solenoid valves are distributed nationally.

SKINNER ELECTRIC VALVES

THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION,
THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT, U.S.A.

PRINTED IN U.S.A.



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COVERS ALL THESE NEW PROCESSES

A new how-to volume on the subject of Chipless Machining—shaping metal parts without the production of chips. This technical book deals with the cold forming of steel by such processes as extrusion, radial forging, spline rolling, power spinning, and explosive forming.

This basic, practical guide is an important addition to your technical library because it brings together hitherto unavailable and widespread information about these newer processes in one convenient, useful text. It describes and illustrates in detail:

- the newer methods of cold forming
- pertinent data on economies resulting from savings in time and materials
- specific product design data and methods information of each process
- the range of various processes, their advantages and limitations—and their typical applications

The emphasis is on practice—theory is at a minimum. An extensive bibliography is provided for each process.

$10.00

502 Pages

326 Illustrations

OF VALUE TO:

TOP MANAGEMENT—Methods of producing improved products, faster and cheaper.
DESIGN ENGINEERS—Design and redesign factors for reducing costs, increasing output.
PROCESS PLANNERS—Comparative advantage of methods.
TOOL ENGINEERS—Essential rules, examples of tools.
PRODUCTION MEN—Details of operation and machines.
PURCHASING EXECUTIVES—Cost saving opportunities described and illustrated

This book can also be used as a reference source in any metal processing or production planning course.

CONTENTS Chipless Machining. What it is and What it is not—Metallurgical Consideration of Plastic Deformation—Cold-Heading—Thread-Rolling—Rolling of Serrations, Splines & Gears—Power Spinning—Rotary Swaging, Radial Forging and Cold Forming of Multiple-Diameter Shafts—Cold Extrusion of Steel—Selecting of Materials and Designing Parts for Cold Extrusion—Applications of Cold Extrusion—Production of Slugs and Secondary Operations—Phosphate Coating and Lubricating for Cold Extrusion—Die Design for Cold Extrusion of Steel—Press Selection for Cold Extrusion—Explosives and Other High-Energy-Rate Forming Methods.

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M10/60

NEW Involute Rolling Machine

with 3 Cylindrical Dies

- **for producing splines faster with greater accuracy**
- **for gear tooth finishing**

The new Reed A-425 heavy duty machine was specially designed for rolling involute splines and serrations and for gear tooth finishing.

The precise tracking of the three self-feeding independently adjusted dies produces accurate involute forms. It gives greater tooth strength and better surface finish. The machine may be automated or equipped with a semi-automatic loading fixture.

For complete information write for Bulletin A-424-1.

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Specialists in Thread and Form Rolling Tools and Equipment

HOLDEN, MASSACHUSETTS, U. S. A.

Sales Offices in: Buffalo, Chicago, Cleveland, Compton, Calif., Denver, Detroit, Englewood, N. J., Houston, Indianapolis, Milwaukee, Montreal, New York City, Phila., Pittsburgh, St. Louis, Syracuse, Toronto

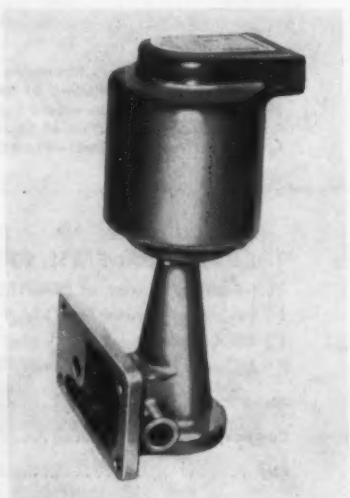
treated to minimize temperature effects when bonded to several different types of materials. They are available in 1/2- and 1/4-inch sizes in 45- and 60-degree configurations on epoxy, paper, or phenolic matrices, depending upon the intended use. By special order they can be furnished to compensate for the temperature variations of almost any material specified.

Circle 633 on Readers' Service Card

Gusher Coolant Pump

Newest in the gusher line of pumps manufactured by the Ruthman Machinery Co., Cincinnati, Ohio, is this sealless Model 9-P3 pump. It is a flange-mounted type with one internal and two external discharge orifices—right- and left-hand, respectively. The pump is primarily designed for machinery having comparatively shallow reservoirs. It will continue to pump until the liquid level is at the extreme bottom of the inlet port. This minimizes any possibility of air locking even with frothing liquids. The prelubricated ball-bearing motor is 1/10 hp, with a one-piece electronically and diametrically balanced shaft connected to the pump. There is no metal-to-metal contact within the impeller housing. The pump has a capacity of 4 gallons per minute.

Circle 634 on Readers' Service Card



DEPENDABLE . . . predictable response to heat treatment every time

Send for Bulletin 102— "Helpful Heat-Treating Hints."

The full uniformity within each bar of Desegatized FM die steel and the consistent uniformity from lot to lot simplifies the heat treatment of your die components. Predictable hardnesses are readily attainable . . . distortion and size change are minimized . . . danger of cracking is lessened!

In free machining FM die steels, full uniformity is achieved through Latrobe's unique Desegatized process of manufacture. This process guarantees an even distribution of carbide particles, free machining alloy sulphides and other alloying elements . . . factors leading to improved machinability, greater toughness and improved wear resistance in addition to the optimum heat-treating characteristics.

Latrobe's 12% chromium FM die steels are available through district steel service centers near you. Grades include: Olympic FM (Type D-2) for long-run applications; GSN FM (Type D-3) non-deforming die steel; Cobalt Chrome FM (Type D-5) for extra resistance to galling and pickup.

Call your Latrobe representative today!

Manufactured by skilled American labor

LATROBE
Metalmasters

LATROBE STEEL COMPANY
LATROBE, PENNSYLVANIA

BRANCH OFFICES and STEEL SERVICE CENTERS: BOSTON • BUFFALO • CHICAGO CLEVELAND • DAYTON • DETROIT • HARTFORD • LOS ANGELES • MIAMI • MILWAUKEE NEW YORK • PHILADELPHIA • PITTSBURGH • SAN LEANDRO • TOLEDO

For more data circle this page number on card at back of book

ONLY

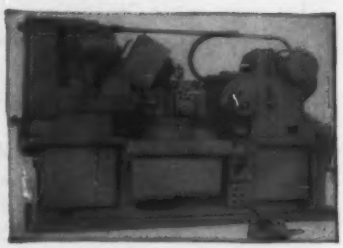
GOSS and DeLEEUW AUTOMATIC CHUCKERS

offer the 1-2-3 feature

This NEW development—unsurpassed for speed, convenience of tooling and precise finish—involves no retooling problem even for short runs. It assures greater production at lower cost on all classes of work.

The unique "1-2-3" feature, exclusive with Goss & De Leeuw, provides the means for performing one to three right or left hand single or double threading operations simultaneously or in sequence, without changing set up.

Here's an ideal machine tool for small lot requirements because of quick, easy changeover. Any class of chuck work can be handled economically in any quantity.



The examples of work shown here are typical of the wider variety of parts being produced on these new machines.

SEND FOR

detailed information on this new machine. Let us have samples of your work in order to give you time and cost estimates for handling it on the "1-2-3" Goss & De Leeuw.

GOSS and DE LEEUW
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

GOSS & DeLEEUW
QUALITY · PRODUCT · QUANTITY

Metron Small-Size Multiple Drill Head

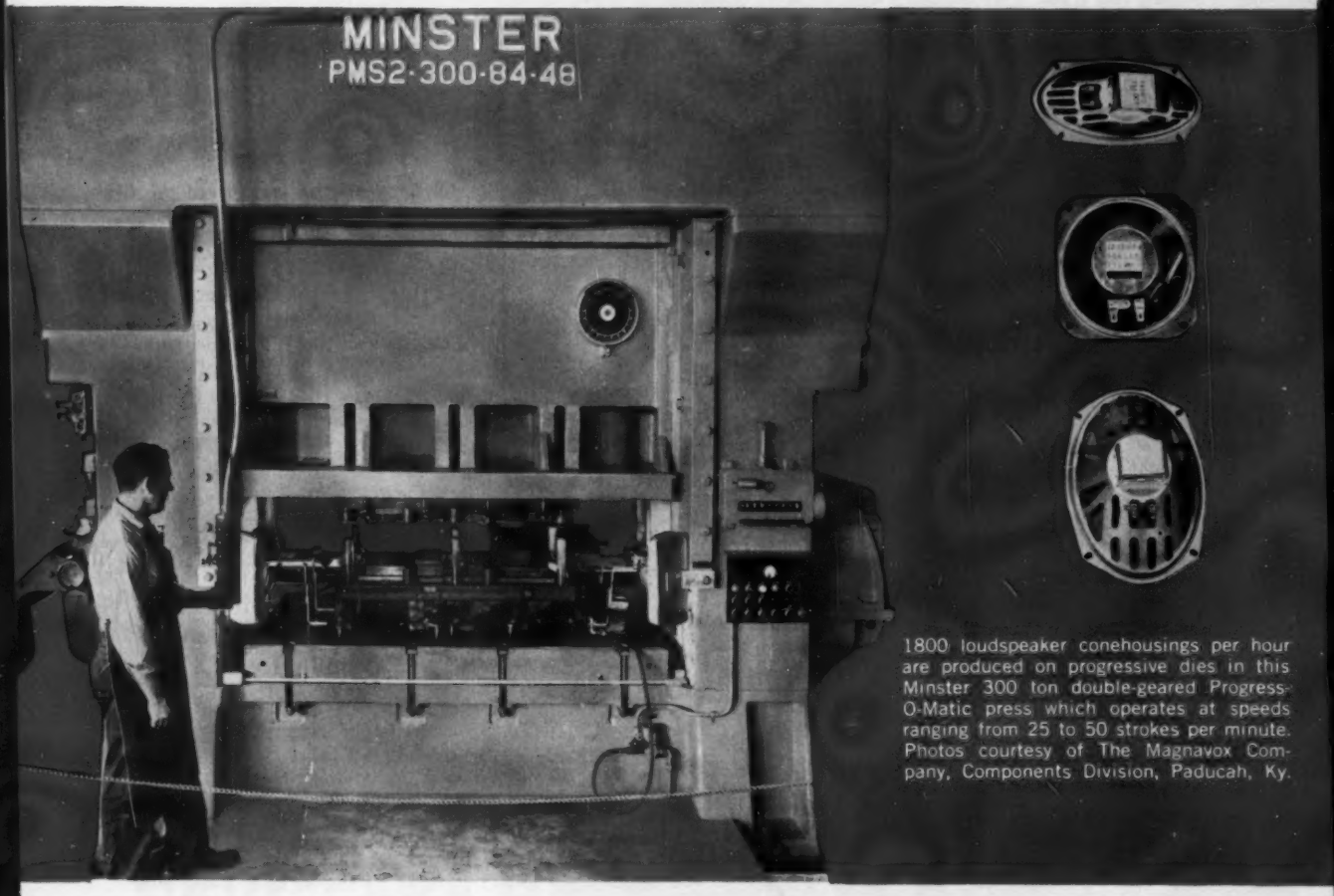
Multiple drill head that provides speeds high enough for very small drills on center distances as small as 3/8 inch announced by Metron Instrument Co., Denver, Colo. Especially designed for precision production of miniaturized parts, this drill head features speed ranges of 0 to 8000 rpm, which makes possible the use of extremely small drills. All spindles are ball-bearing mounted; gears are case-hardened; hole-center tolerances are plus or minus 0.001 inch; maximum distance between centers is 3 inches; and maximum drill size, No. 20. Made in case sizes 2, 3, or 4 inches in diameter, depending upon the particular requirements of individual user. Each drill head is especially designed and built to user's production requirements.

Circle 635 on Readers' Service Card

Wooden Storage Cases for Micrometers

One of a new line of practical

AUTOMATIC PRODUCTION reduces costs...savings pay for the press



1800 loudspeaker conehousings per hour are produced on progressive dies in this Minster 300 ton double-geared Progress-O-Matic press which operates at speeds ranging from 25 to 50 strokes per minute. Photos courtesy of The Magnavox Company, Components Division, Paducah, Ky.

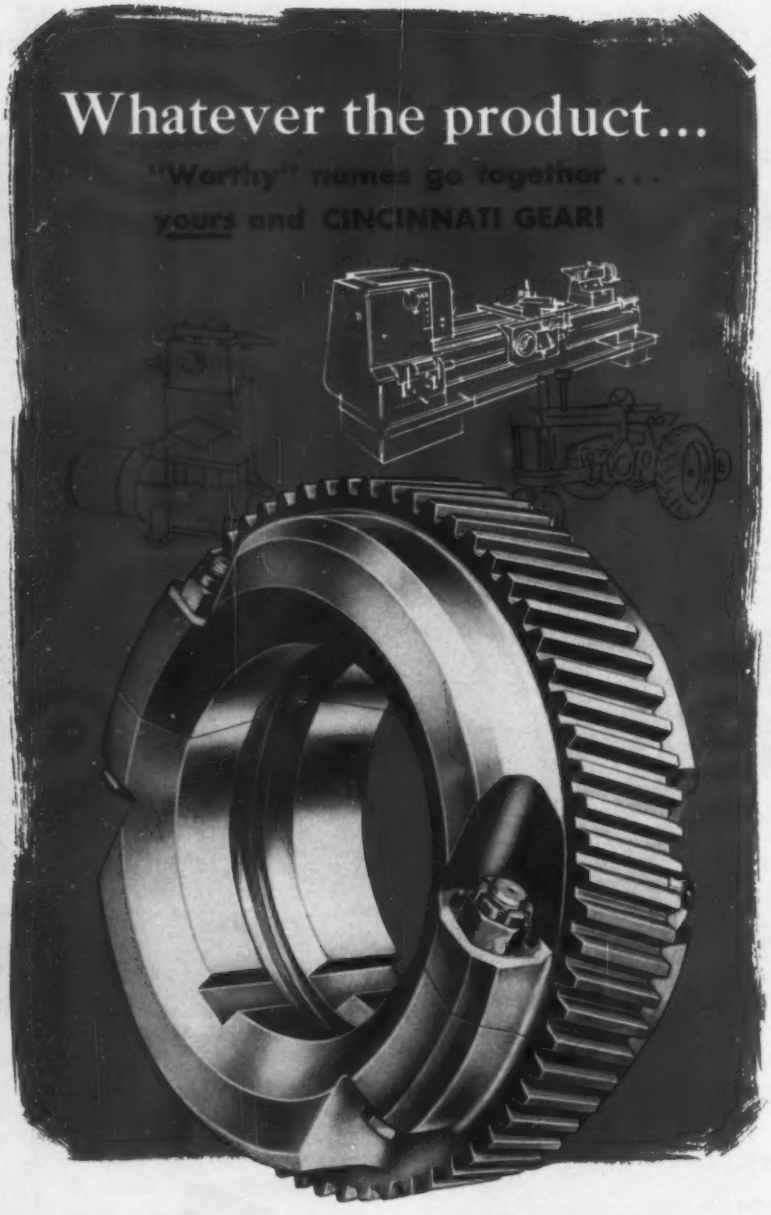
For Magnavox . . . this MINSTER Progress-O-Matic Press

saves 600% direct labor cost
saves 90% die maintenance cost
saves 75% die set-up time cost
saves 25% material cost
cut finished part cost by 50%

The interesting story on how Magnavox engineers achieved this outstanding cost reduction is contained in a reprint of an article which recently appeared in a leading magazine. May we send you a copy? Write to:

The Minster Machine Company • Minster, Ohio

MINSTER®



This trademark on a gear is the GUARANTEE of a quality-conscious gear manufacturer.

CINCINNATI GEAR has kept in the forefront of technological progress in gear-making methods and equipment for over 50 years. The oldest "tool" in our ultra-modern shop is *pride in true craftsmanship!*

Send for NEW 32-page Technical Brochure

CINTI

THE CINCINNATI GEAR CO.

Wooster Pike and Mariemont Ave. Cincinnati 27, Ohio
Custom Gear Makers Since 1907

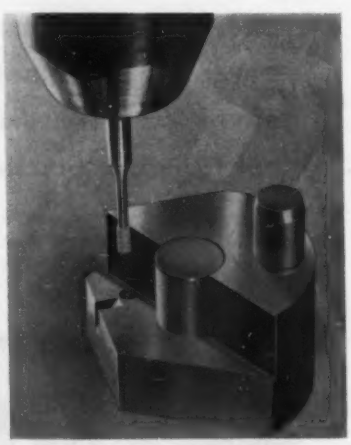
GEARS, good gears only

and attractive wooden storage cases for holding micrometer sets introduced by the J. T. Slocomb Co., South Glastonbury, Conn. Three different cases are included in the line. The 0- to 6-inch case holds six micrometers of varying sizes ranging from 0 to 6 inches. It is 7 1/2 inches deep, 5 1/2 inches wide, and 14 inches long. The 6- to 12-inch case accommodates six micrometers from the 6- to 12-inch size and is 10 inches deep, 9 inches wide, and 20 inches long. The 0- to 12-inch case contains twelve micrometers ranging from the 0- to 12-inch size. It is 11 1/2 inches deep, 13 1/2 inches wide, and 20 1/4 inches long. All cases are made of mahogany and carefully selected fine-grade hardwoods. They are finished and lacquered to preserve their utility and appearance.

Circle 636 on Readers' Service Card

Diamond Mandrel for Precision Grinding of Small Holes

Precision grinding of small holes in all kinds of material can be done rapidly with this new diamond mandrel introduced by the Precision Diamond Tool Co., Elgin, Ill. The shanks of these mandrels are hardened and ground to size within very close limits. Diamonds are mounted under controlled atmospheric conditions by a patented electronic method that causes the sharpest edges of the diamonds to protrude



Precision Diamond abrasive mandrel for small-hole grinding made by Precision Diamond Tool Co.

NEW 'Long Bed' 10" Metal Lathe offers capacity up to 36"

Delta 10" Metal Lathe with Long Bed (36" between centers) available in bench or cabinet models with a complete line of accessories.

Be sure to register and vote

Now Delta introduces the "big brother" to the famous 10" Metal Lathe—with a big 36" capacity between centers and an exclusive combination of features that make it the big value in its class.

This new model fills the need for a low-cost, precision lathe capable of handling heavy duty work in production, in plant maintenance shops and in tool rooms. In addition to extra capacity, it provides: variable speed drive with choice of speeds from 50 to 1500 rpm, quick change gear box allowing selection of 54 feed rates or thread pitches, and ¾" collet capacity—largest available in any comparable lathe.

See your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages) about the many other extra performance features you get. For FREE catalog describing the complete line of Delta Metal Lathes, write: Rockwell Manufacturing Company, Delta Power Tool Division, 614K N. Lexington Ave., Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

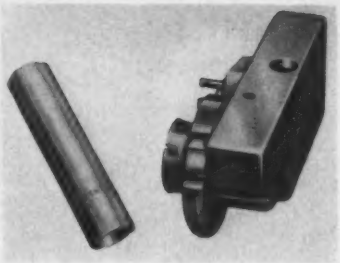
DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

on the mandrel, making it extremely helpful in grinding even the hardest heat-sensitive steels. Holes as small as 0.022 inch can be ground accurately and rapidly. In addition to their wide usage on jig-grinding equipment, these mandrels can be employed for precision internal grinding. The new mandrels are especially well adapted for use in the production of carbide drawing and header dies. They are available in a complete range of sizes from 0.018 to 3/4 inch in diameter.

Circle 637 on Readers' Service Card



Sossner Rol-A-Matic marking attachment for screw machines

Marking Attachment for Automatic Screw Machines

A precision automatic screw machine attachment, designed for light marking or imprinting round, hollow, or solid stock on turret lathes with from one to six spindles, is announced by Sossner Steel Stamps, Inc., New York City. This device, called the Rol-A-Matic, can be attached to either the front or rear cross-slide. It consists of only two moving parts and can be easily applied. Advantages claimed for this attachment are versatility, ruggedness, simple construction, and low price.

Circle 638 on Readers' Service Card

Continental Counterbores for Socket-Head Screws

The Continental Tool Works Division of Ex-Cell-O Corporation, Detroit, Mich., is manufacturing a set of counterbores consisting of sizes arranged to suit the latest "1960 Series" socket-head cap-screws. In most cases the new series cap-screws have larger head diameters designed to carry greater loads without indenting the material being fastened. The new counterbores are known as the 1B standard toolroom set.

The counterbores are furnished in an oak box in which they are arranged for easy identification of

Counterbores for socket-head screws made by Continental Tool Works Division

Use The STUDER RHU-450 For

- Universal Grinding
- Electronic Size Control
- Match Grinding

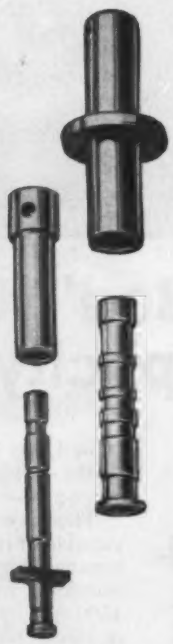
Studer RHU-450 Universal Grinder with electronic equipment.

Special electronic measuring controls on the new Studer RHU-450 Universal Precision Grinder permit extremely fine accuracy and a more versatile range of grinding operations for match grinding, internal and external grinding, superfine and lap grinding.

MOVOLIMIT Electronic Size Control, for highly accurate grinding to pre-determined diameter from a master part or the first workpiece in the run. The grinding operation is controlled automatically, independent of grinding wheel wear.

DELTALIMIT Match Grinding Instrument, for match grinding a shaft to fit a specific bore diameter. DELTALIMIT equipment is ideal for grinding servo valves, plungers and barrels, and other mating parts requiring tolerances in the millionths.

Other Features—handles workpieces up to 18" between centers with 8" swing—workspindle speed infinitely variable from 30 to 650 rpm—cylindrical cam grinding attachment—taper grinding attachment.



Electronically mated parts produced on a Studer RHU-450.

Write For More Information

COSA

Importers of Leading Precision Machine Tools
Nationwide Sales and Service
COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

In CANADA contact COSA CORPORATION OF CANADA, LTD., 1160 Lakeshore Road, Long Branch, Toronto 14, Ont.

Ten-station transfer machine in use at major auto plant. This view shows 9 of the 45 A-B Bulletin 836 pressure switches and 2 special Allen-Bradley control stations on the machine.

ALLEN-BRADLEY

OILTIGHT

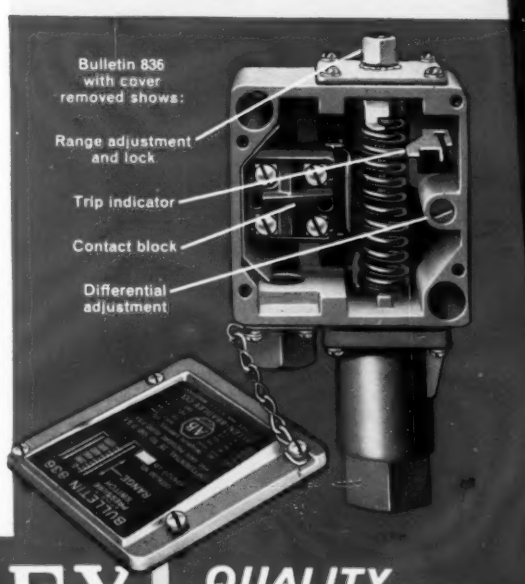
Pressure Switches

provide consistent accuracy and maximum reliability

Bulletin 836 Style T
Oiltight Pressure Switch

These rugged Allen-Bradley Bulletin 836 Style T oiltight pressure switches are specifically designed to take the punishment of hard, day-in and day-out industrial use. The die-cast aluminum housing is completely sealed. Oil cannot get in and foul the contacts—even when it flows over the enclosure in a continuous stream. The precision switch mechanism insures extreme accuracy of repeatability. An extremely important feature lies in the "snap action" of this switch—it maintains its normal contact pressure up to the instant of switchover—regardless of how slowly the trip point is approached. Contact chatter—which means unreliable operation—is impossible, and contact life is greatly increased. The contact block has two isolated circuits with one N.O. and one N.C. set of contacts.

Both the operating pressure and the differential are adjustable. The pressure is externally adjustable with the setting shown on a calibrated scale, and a trip indicator shows the operating point. These A-B *quality* controls are made for operating at pressures up to 5000 psi. Write for full details.

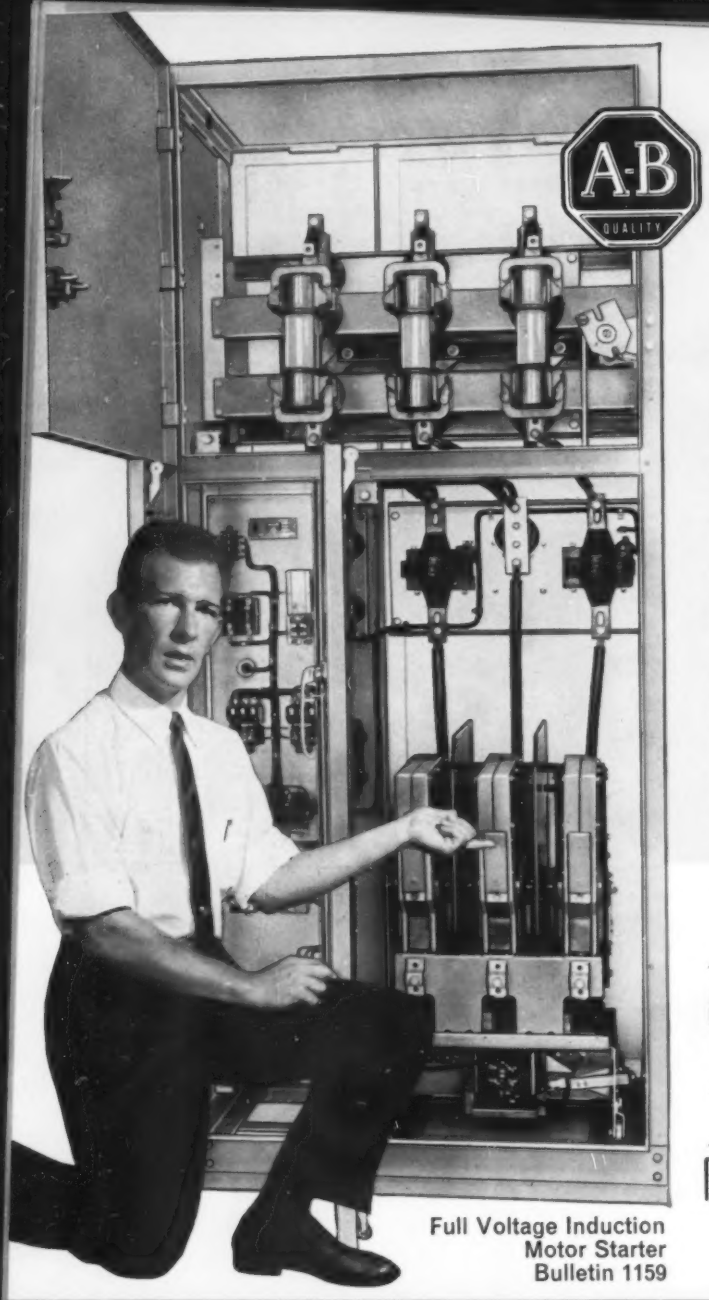


ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

QUALITY MOTOR CONTROL



Full Voltage Induction
Motor Starter
Bulletin 1159

The only HIGH VOLTAGE STARTERS

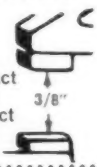
built to provide millions of trouble free operations

An astounding claim but true! The secret of this remarkable operating life of Allen-Bradley high voltage air break starters is found in the extremely short contact travel—*it's only 3/8"*. Thus, pounding and contact wear are reduced to a minimum. In addition, contactors in A-B high voltage starters have only ONE moving part. It's the same simple solenoid design that has proved good for millions of trouble free operations in A-B low voltage starters. And like A-B low voltage starters, the double break, silver alloy contacts never need maintenance. For complete details on Allen-Bradley high voltage starters, send for Publication 6080.

FEATURES OF THE ALLEN-BRADLEY RUGGED SOLENOID AIR BREAK CONTACTOR

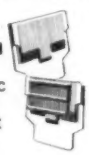
ONE MOVING PART
All trouble-causing pivots, pins, and flexible jumpers are eliminated.

CONTACT TRAVEL ONLY 3/8"
Reduced impact and pounding extends contact operating life.

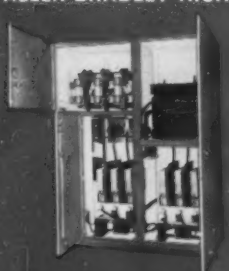


DOUBLE BREAK CONTACTS
of silver alloy completely eliminate the need for contact maintenance.

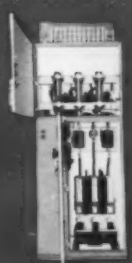
FAST ARC SUPPRESSION
New blowout design, new arc chutes molded of arc resistant material.



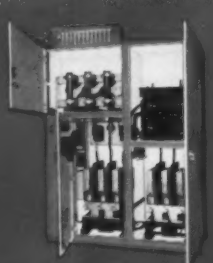
ALLEN-BRADLEY HIGH VOLTAGE STARTERS ARE MADE FOR ALL TYPES OF MOTORS AND ALL TYPES OF SERVICE



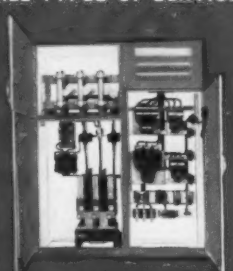
Reduced Voltage
Induction Motor Starter
Bulletin 1172



Full Voltage
Synchronous Motor Starter
Bulletin 966



Reduced Voltage
Synchronous Motor Starter
Bulletin 983



Wound Rotor Motor Starter
Bulletin 1180

ALLEN-BRADLEY

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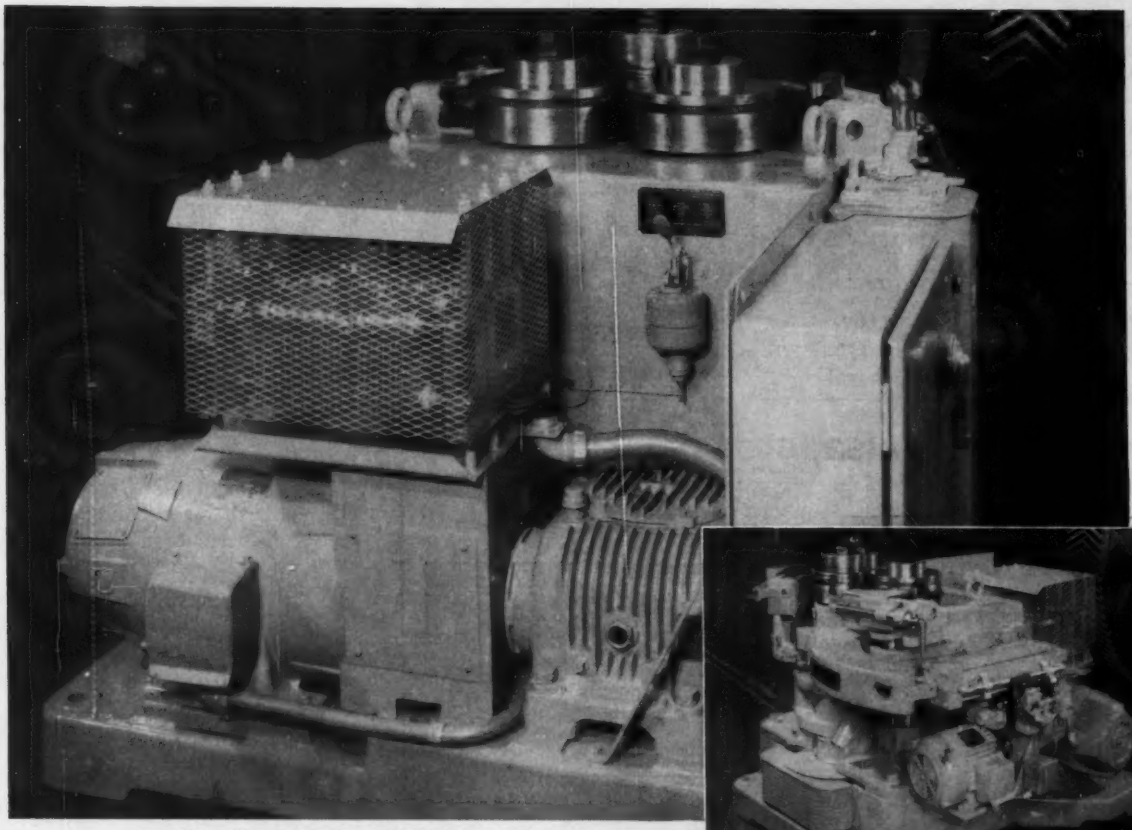
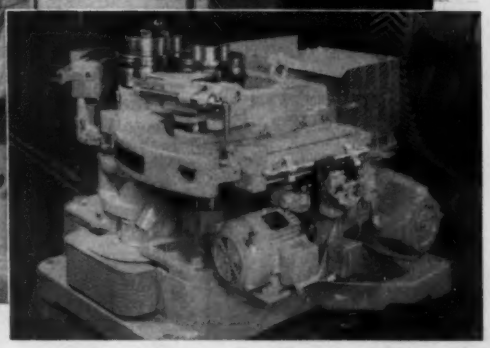
QUALITY MOTOR CONTROL

12-60-MR



New No. 1 Horizontal Bending Roll



Note Hydraulic Roll Adjustment

SPEED DIE-LESS COLD METAL BENDING WITH IMPROVED 'BUFFALO' BENDING ROLLS

- *Fast* Production Bending of Circles, Arcs and Spirals to Commercial Accuracy.
- *Hydraulic* Roll Adjustment Speeds Setup Time.
- *New,* Compact Design Saves Valuable Floor Space.
- *Handle* Angles, Rounds, Squares, Tubes, Pipes, Flats and Special Shapes.
- *Easily* Changed Rolls Eliminate Need for Expensive Dies.
- *Models* and Sizes to Handle All Types of Work.

Improved 'Buffalo' Bending Rolls are engineered for peak accuracy. Rugged construction insures long, trouble-free life. Optional attachments available.

See how 'Buffalo' Bending Rolls can save you production and maintenance time and money. For complete facts, contact your 'Buffalo' machine tool dealer or write the factory direct.

MACHINE TOOL DIVISION

BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

For more data circle this page number on card at back of book

each size. The box contains counterbores to suit screw heads from No. 6 through the 5/8-inch diameter size, together with necessary pilots and holders. Three countersinks for 60-, 80-, and 90-degree included angles are also provided. The original No. 1 standard toolroom set will continue to be available from the manufacturer.

Circle 639 on Readers' Service Card

Slocomb Dial Micrometer

Quick-acting, easy-to-read, 1/2-inch dial micrometer introduced

by the J. T. Slocomb Co., South Glastonbury, Conn. This micrometer is especially designed for use in repetitive measuring operations where the simple top reading dial facilitates rapid measuring. It has a range of 0 to 1/2 inch and will measure 2 inches from the edge of a flat plate, or to the center of a 4-inch sheet. Because of its deep-throated frame and design, the micrometer can be used with one hand, leaving the other hand free to handle work being measured. A unique adjusting-nut assembly, which provides full engagement with the spindle thread, makes the ordinarily delicate instrument shockproof. It is claimed that this micrometer will still be in perfect operating order even after being accidentally dropped on the floor.

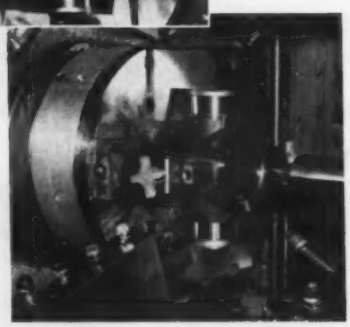
Circle 640 on Readers' Service Card

Orbit Valve, Tulsa, proves it again:

"You make money every time you chuck with *Buck*"

Shows clever, equalizing fixtures and top jaws developed by Orbit which work in conjunction with the 2 jaws of the Buck power chuck.

Operator places valve in position for machining. Lathe is a 3 AC Warner & Swasey Automatic.



Final operating step: finish reaming. Four other operations include — rough face of valve body flange, rough drill, and rough bore; rough drill trunnion diameter, rough out bonnet diameter; cut core clearance, finish bonnet diameter; finish trunnion diameter and bottom of trunnion. Trunnion tolerances and concentricity must be within .003".

The continual plant modernization program of Orbit Valve Co., Tulsa, Oklahoma — pioneer producer of valves for handling petroleum and petrochemicals — resulted recently in saving 18 hours a week on valve body production.

The major change was from hand turret lathe operation to automatics, using the Buck Aluminum body power chuck. It could be done because of the Buck precision capabilities.

Future expected improvements are a 10% increase in production, major time-savings on a former true-up operation, and consistent quality that will reduce inspection time.

The Buck Ajust-Tru® principle guarantees precision within .001" on automatics, and provides many other distinct advantages. Send for a catalog. See why "It pays to chuck with Buck."

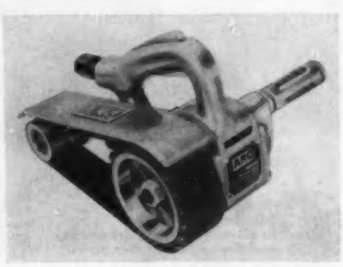
Makers of Scroll, Power, Dust Proof, Independent Chucks.

BUCK TOOL COMPANY

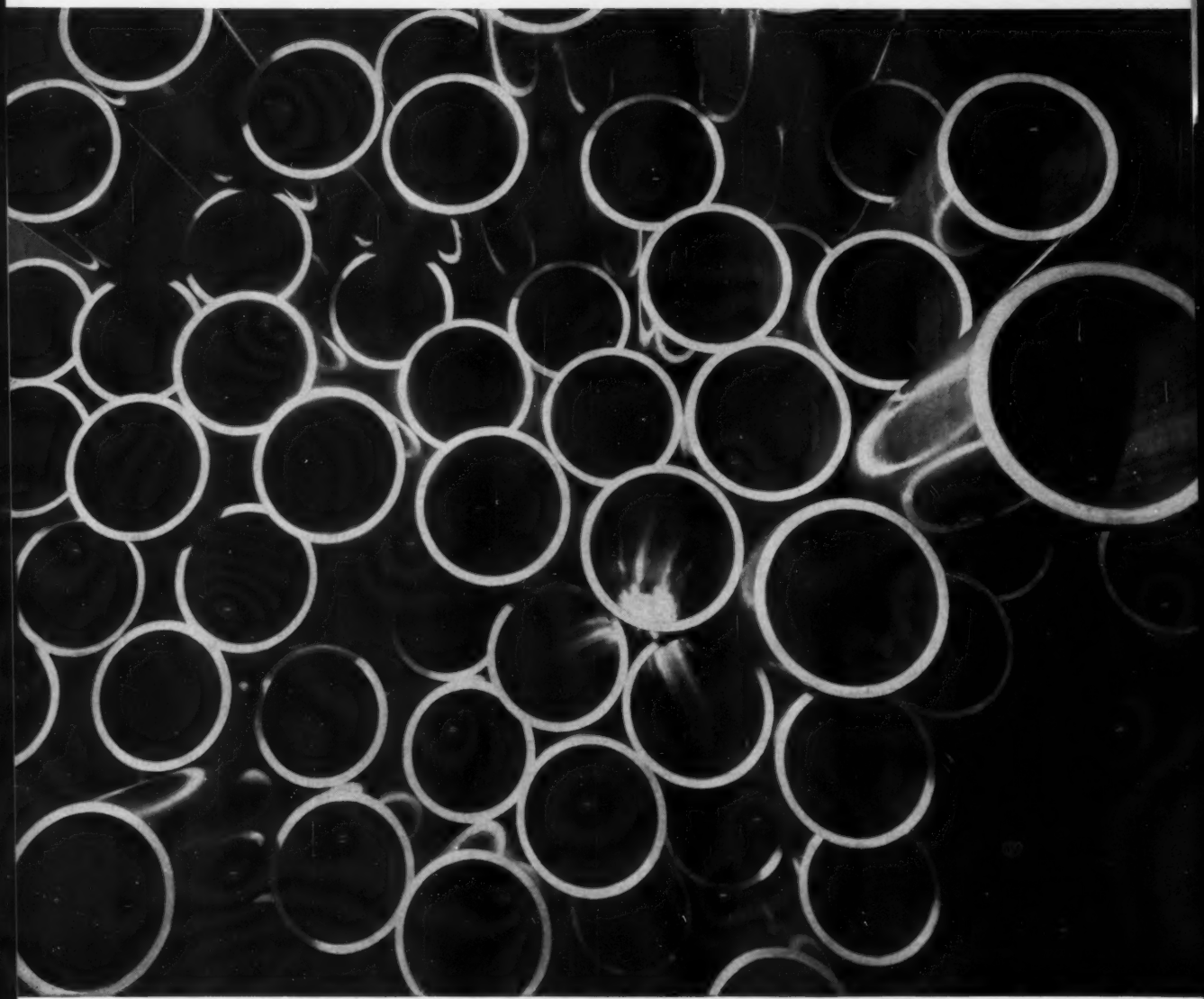
1020 SCHIPPERS LANE • KALAMAZOO, MICH.

Aro Portable Belt Grinder

Portable abrasive belt grinder announced as the latest addition to the air tool line manufactured by the Industrial Division of Aro Equipment Corporation, Bryan, Ohio. This tool is designed for exceptionally fast grinding and finishing of metal. It combines the backstand idler principle of power abrasive grinding with portability for greater flexibility and efficiency. Live action of the coated abrasive belt running at high speed (7000 sfpm belt speed) over a resilient rubber contact wheel with slotted face actually sets the abrasive grains "on edge." This provides a shearing action and increases grinding and finishing speed. Chattering, bumping, or bouncing during finishing of rough surfaces are said to have been eliminated because of the resilient rubber contact wheel which supports the abrasive belt. Cooling action of air, which is constantly circulated through the



This mark tells you a product is made of modern, dependable Steel.



Look at the dimensional accuracy and smoothness

You can reduce the costs and processing time of parts-making by using USS National Electric-Resistance Welded Mechanical Tubing. It eliminates drilling operations. It lets you replace drills with simple, less expensive boring tools. Mechanical Tubing reduces tool wear and tool changes.

USS National Electric Welded Mechanical Tubing is an ideal load-carrying member. It resists bending stresses equally in all directions and gives you a superior cross section. It absorbs and localizes shock. In torsion, it provides better material distribution. And for a given weight, mechanical tubing withstands more load than other sections.

USS National Electric Welded Mechanical Tubing is available in cold-drawn or hot-rolled sizes ⅜″ thru 5½″ and in wall thicknesses .035″ to .250″. It can be obtained from National Tube Distributors located throughout the country. They will gladly show you how to use USS National Welded Mechanical Tubing in your next application. *See your USS National Tube Distributor.*

USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Supply Division
United States Steel Export Company, New York

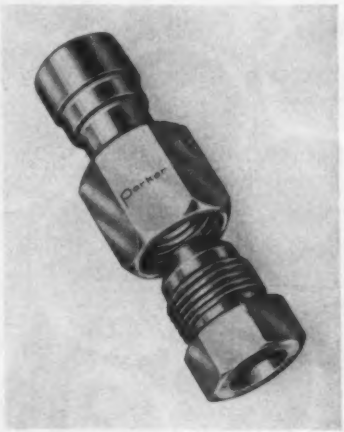
For more data circle this page number on card at back of book

slots in the contact wheel, keeps the abrasive belt running cool and lengthens its life. Free belt stropping of corners and radii is also said to be readily accomplished with this new tool by simply applying the belt to the work between the contact wheel and the idler pulley. The tool is powered by a 2-hp air motor which provides for handling the toughest grinding and finishing jobs. Hardness of contact wheel is optional. Medium, hard, or extra-hard wheels are available, progressing in that order from the grinding and polishing wheel to the hardest grade used for heavy stock removal. Contact wheels 1 and 2 inches wide may be used, without spacers or adapters. The belt is completely guarded so that it is directed downward in case of breakage. The governor incorporates the latest safety features. A safety type throttle is provided which will not admit air to the tool unless the latch beneath the handle grip is depressed.

Circle 641 on Readers' Service Card

Parker Threaded Union for Brazed Tubing

Threaded union recently added to the line of Braze-lok tube fittings announced by Parker Fittings & Hose Division, Parker-Hannifin Corporation, Cleveland, Ohio. The Braze-lok fitting, with a prepositioned brazing ring inside the socket, provides a semipermanent, brazed tubing joint to assure non-leak connections for high pressure and other critical service. This union is offered in response to the demand for a disconnectable joint in Braze-lok fitted circuits. It consists of two parts, each of which has the Braze-lok socket for brazing to the tube. One part has the SAE hydraulic 37-degree flare cone (as used by the Triple-lok tube fitting), while the other part has a swivel nut to mate with the straight-threaded cone to provide a metal-to-metal seating. The two-piece union is offered in steel and stainless steel, for tubing from 1/4 through 2 inches in outside diameter.

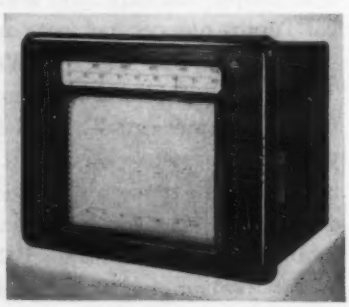


Circle 642 on Readers' Service Card

Wheelco Pressure and Temperature Recorder

Combination pressure and temperature recorder in the 8000 series announced by the Wheelco Instruments Division of Barber-Colman Co., Rockford, Ill. This electronic potentiometer recorder is completely self-contained and uses a constant voltage source instead of the conventional standard cell for standardization. The new unit will record one or more points of pressure and up to twenty-three points of temperature. Designed for use in connection with extruders, in the plastic industry, the extreme flexibility of the recorder makes it well adapted for use in other areas of industry. While the standard unit has a temperature range of 0 to 800 degrees F., other ranges are available. Likewise, a variety of pressure ranges are available, even though the standard recorder has a range of 0 to 10,000 psig. Zero and span adjustment are provided for the full pressure range.

Circle 643 on Readers' Service Card



FASTER AUTOMATIC CUT-OFF
Tubing, Pipe and Bar Stock

The Modern Way

Automatic operation—from loading to final cut-off. Handles solid bar stock up to 3" O.D.—tubing up to 8" O.D. Cuts any material that can be turned. 16 spindle speeds.

The Modern Automatic Cutting-Off Machine and Bar Feeder Combination, shown above, handles random lengths of tubing, pipe and bar stock. With this combination the entire load is fed to the cutting-off machine without attention of an operator. Feeders are available for any maximum length bars. Only one single crank adjustment needed—for stock diameter.

WRITE FOR CATALOG

Has complete specifications of all models. Illustrates parts that are being formed, grooved, flanged or chamfered and cut off in a single operation at a high rate of speed. Also describes the automatic feeder, hot spinning machine for sealing ends of tubing, and the Modern Safety Drill Table.

107

MODERN MACHINE TOOL CO.
2005 LOSEY AVENUE
Jackson, Michigan

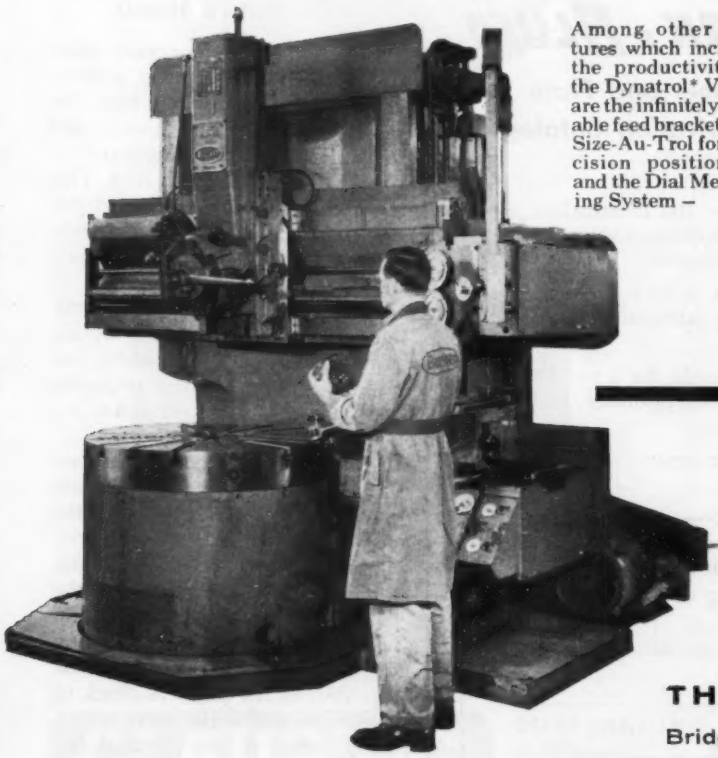
FINGER-TIP CONTROL

Increases Productivity of...

BULLARD

DYNATROL*
VERTICAL TURRET LATHES

Directional control of all head motions in feed on traverse, either horizontally, vertically or at any 45° angle, as well as table start and stop from a lightweight portable pendant, is a distinct production advantage.



Among other features which increase the productivity of the Dynatrol* V.T.L. are the infinitely variable feed bracket with Size-Au-Trol for precision positioning, and the Dial Measuring System –

It allows the operator to always be in the most advantageous position in relation to the work and eliminates the necessity of climbing for buttons or levers. By reducing operator fatigue and increasing his efficiency, more metal is removed per hour with a lower cost per piece.

*TRADE MARK

ask your Bullard Sales Engineer for the complete Dynatrol story or write for catalog.

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Bridgeport 9, Conn., Telephone EDison 6-2511

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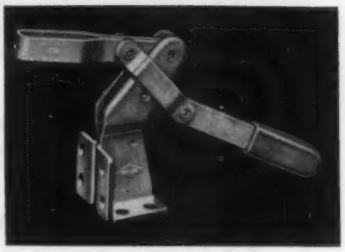

Wespo Flipper Type Clamp

Model 320 base-mounted flipper type clamp, designed particularly for use where maximum clearance for removal of the work is required, recently added to the line of fixture clamps made by the Wespo Division, Vlier Engineering Corporation, Detroit, Mich. The U-formed bar of this clamp accommodates a 5/16-inch spindle. All bushings and rivets are hardened for greater strength. The entire clamp is cadmium-plated to resist rust. Over-all height is 3 1/4 inches.

Circle 644 on Readers' Service Card

Immersion Thermocouple for Molten Metals

An expendable immersion thermocouple for measuring molten-metal temperatures has been developed by the Instruments and Systems Division of Engelhard Industries, Inc., Newark, N. J. This equipment has been designed primarily for measuring the temperatures of molten steel in both open hearth and electric furnaces. It may also be used with equal efficiency for other molten metals. This unit is said to combine improved economy, faster response, high accuracy, and simplified assembly.

The simple expendable thermocouple consists of a ceramic base which serves as a mounting for the noble-metal thermocouple wires. A firmly anchored, transparent, fused silica tube protects the thermocouple wires and is, in turn, protected from slag and floating solids by a special metal cap. The cap absorbs the physical shock of immersion and melts away immediately after it has plunged beneath the slag. The molten metal cannot penetrate the assembly and damage the plug receptacle.

Circle 645 on Readers' Service Card

875 DOLLARS

Buys this CLAUSING Vertical Miller

And look what you get!

1. **ACCURACY VERIFIED** to within TENTHS—
   - Spindle taper (internal) runout within .0002″ at spindle nose.
   - Spindle square with table, front to rear; within .001″ TIR in 5″ circle.
   - Top of table square with column ways within .0005″ in 6″ travel.
   - Table T-slots parallel to table dovetail ways within .0005″ in 8″ longitudinal travel.

   These and other tests showing exact indicator readings are on the report accompanying your machine.

2. **VERSATILITY**—The Clausing mills, drills, bores, reams, and shapes . . . at all angles . . . with one work set-up! It's perfect for general production, experimental, layout, and light jig-bore work.

3. **EFFICIENCY**—Users report that "*the Clausing is the easiest to set up, get around and operate of any mill . . . and it has sensitivity you don't get in larger machines—a mighty important factor when using small cutters.*"

Make any comparison you want . . . We're sure you'll agree the CLAUSING vertical mill is truly an *outstanding* machine tool value! Write for a catalog today.

348

CLAUSING
DIVISION OF
ATLAS PRESS COMPANY

OUTSTANDING VALUES IN PRECISION EQUIPMENT

10-110 N. PITCHER STREET, KALAMAZOO, MICHIGAN

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News OF THE INDUSTRY

California

ROBERT A. WORRELL, JR., joins HARRON, RICKARD & MCCONE CO. of Northern California in the capacity of vice-president and general manager. Mr. Worrell has spent the past fourteen years with the CINCINNATI MILLING MACHINE CO., serving in the capacity of sales engineer in the Detroit, Mich., territory for the past five years. He will be principal assistant to J. O. ELLISON, president of the West Coast firm.

Robert A. Worrell, Jr., vice-president and general manager of Harron, Rickard & McCone Co. of Northern California

U. S. INDUSTRIES, INC., New York City, has sold the business and principal assets of its USI Montebello division to H. W. LOUD MACHINE WORKS, INC., Pomona, Calif. The sale included some 200,000 square feet of plant under roof and approximately 20 acres of land in Montebello, Calif., on the outskirts of Los Angeles.

STANDARD GAGE CO., INC., Poughkeepsie, N. Y., announces the expansion of its sales and engineering service departments with the opening of a factory branch office in Los Angeles, Calif. DAVE POLLOCK has been named resident manager of sales for this area.

FUTURMILL, INC., Pontiac, Mich., and its exclusive licensee, WESSON CO., have granted a sublicense to WETMORE TOOL & ENGINEERING CO. of Los Angeles, Calif., to manufacture and sell indexable blade milling cutters under Futurmill's milling cutter patents.

BURG TOOL MFG. CO., INC., Gardena, Calif., is expanding its present manufacturing facilities by 31,520 square feet. The addition will provide new general offices and machine assembly area, and will also house the Burgmaster Division.

C. H. BRITTENHAM has been named manufacturing manager of the PACIFIC MFG. DIVISION, Federal Pacific Electric Co., Newark, N. J. In his new position, Mr. Brittenham will be in charge of manufacturing operations at Federal Pacific's new 250,000-square-foot plant at Santa Clara, Calif.

C. H. Brittenham, manufacturing manager—Pacific Mfg. Division, Federal Pacific Electric Co.

Illinois and Indiana

RONALD J. MCCARTHY has been named field engineer for DENISON ENGINEERING DIVISION, American Brake Shoe Co., Columbus, Ohio. Mr. McCarthy will be located in Denison's midwest regional office at 7000 W. 63rd St., Chicago 38, Ill., and will be responsible for the sale of hydraulic pumps, motors, and controls in the states of Wisconsin, Minnesota, North and South Dakota, and upper Michigan.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, announced that FLUIDLINE ENGINEERING INC., 2153 N. Lincoln Ave., Chicago 14, Ill., has been franchised to take over the distributorship on Parker industrial tube and hose fittings, accumulators, and related hydraulic items formerly handled by WALLACE TUBE DIVISION. FRANK J. LAMMERS and ARNOLD JOHNSON are principals at Fluidline.

ERNEST JOY LANE has been named regional metallurgist to handle technical service problems in the midwest area by CARPENTER STEEL CO., Reading, Pa. He will work out of the firm's Chicago office and warehouse located at 4501 James Place, Melrose Park, Ill.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, has announced the franchisement of MANUFACTURER SUPPLY CO., 1154 N. Monitor Ave., Chicago 51, Ill., as a distributor for their Crown compressed air preparation units.

WILLIAM J. ERVIN has been named assistant to the midwestern regional manager of CARPENTER STEEL CO., Reading, Pa. He will work out of the Indianapolis, Ind., office and warehouse at 1618 W. Washington St.

Michigan and Wisconsin

MICHIGAN ABRASIVE CO., Detroit, Mich., announced the election of FRED P. HAUCK as executive vice-president and ROBERT C. DICKEY as vice-president in charge of manufacturing. In 1948, Mr. Hauck was elected vice-president in charge of research and manufacturing, and served in that capacity until his present appointment. Mr. Dickey entered the coated abrasives manufacturing

HOW HEAVY A LOAD

can a ball bearing carry?

Federal Ball Bearings make light work of the heaviest loads. *Quiet* work, too. We use SAE 52100 steel and engineer extra stamina into every ball and raceway. Each bearing goes through scores of production and quality control steps because, frankly, we're terrible cranks about precision. We insist that you should be able to mount a ball bearing—and forget it.

Our customers seem to like this idea. And they include the most respected names in American industry. So, when you want to take a work load off your shoulders, put it on a Federal Ball Bearing. Our catalog lists over 12,000 ball bearing sizes, hundreds of types. Send for it.

THE FEDERAL BEARINGS CO., INC., Poughkeepsie, N. Y.

Federal

BALL BEARINGS

One of America's largest ball bearing manufacturers

FEDERAL ON FILM—A 16 mm. color sound film takes you through our 400,000 sq. ft. plant. Loaned free. Just ask for it.

industry as research and service engineer. He later assumed duties as plant manager at Michigan Abrasive until his present election to the executive staff.

JOHN B. HOLLAND has been appointed automotive division manager of OAKITE PRODUCTS, INC., New York

John B. Holland, newly appointed automotive division manager of Oakite Products, Inc.

City. He will make his headquarters in the General Motors Building in Detroit, Mich., but will travel extensively to other automotive centers.

RICHARD E. RASSEL has been appointed to the newly created post of manager of automotive press sales, E. W. BLISS CO., Canton, Ohio. In this position, Mr. Rassel will coordinate all automotive press sales throughout the United States. His office will be located at Bliss' Detroit, Mich., regional offices at 6770 E. Davison Ave.

A further expansion of its service and sales organization has been announced by WESSON CO., Ferndale, Mich., with the appointments of WARREN M. SNYDER as sales and service engineer for the east central district and ROBERT J. JENKINS as service engineer for the mid-continent district.

BELMONT PINNEY has been appointed to the new position of assistant division manager, Hastings, Mich., division of the E. W. BLISS Co., Canton, Ohio.

A major step in the comeback operation of VINCO CORPORATION, Detroit, Mich., was the appointment of ALLISTAIR DUNN as executive vice-president. Mr. Dunn was formerly director of manufacturing for the OHIO INJECTOR CO.

RACINE HYDRAULICS & MACHINERY, INC., Racine, Wis., announced a cross-licensing agreement with VICKERS-ARMSTRONGS (ENGINEERS) LTD., a wholly owned subsidiary of Vickers, Limited, of London, England. The reciprocal agreement with the giant British concern adds very large, high-pressure equipment to the Racine manufacturer's line of hydraulic products and gives it complete coverage of all industrial hydraulic applications. In addition to importing this British equipment and distributing it throughout the countries of North and South America, Racine Hydraulics will commence the manufacture of certain elements of the Vickers-Armstrongs line in its Racine plant during the next year.

New England

PRATT & WHITNEY CO., INC., West Hartford, Conn., will distribute a line of milling, boring, and combined machines, some of which are built in Italy, and others in Japan. The companies involved besides Pratt & Whitney are INNOCENTI S. G. of Milan, Italy, and MITSUBISHI ZOSEN KABUSHIKI KAISHA (Mitsubishi Ship Building & Engineering Co., Ltd.) of Tokyo, Japan.

NORMA-HOFFMANN BEARINGS CORPORATION, Stamford, Conn., has elected HOWARD A. BAXTER vice-president in charge of engineering,

Howard A. Baxter, vice-president in charge of engineering, Norma-Hoffmann Bearings Corporation

including machine and product development, sales engineering, and research.

FRANCE Q. WILSON has been appointed vice-president for marketing by the WATERBURY FARREL FOUNDRY & MACHINE CO., division of Textron Inc., Waterbury, Conn.

Three new appointments in the sales force of NORTON CO., Worcester, Mass., have been announced: WILLIAM C. HOWARD, JR., was named supervisor of distributor sales promotion. He will co-ordinate sales promotion efforts of Norton Co. and its network of distributors in 283 cities. EDWIN A. DANIELSON was appointed abrasive engineer in the Connecticut district. JOHN W. PETERSON became abrasive engineer in the Denver, Colo., district.

JAMES W. DOPP has been named vice-president of LAPOINTE MACHINE CO., Hudson, Mass., exclusive United States representative for a number of British manufacturers of precision machine tools. Mr. Dopp will continue to serve as sales manager of the company, directing the distribution of these machine tools through the Lapointe sales force and selected distributors in strategic cities throughout the country.

ERICK O. PIERSON has been named works manager of the SACO-LOWELL AUTOMOTIVE DIVISION, Saco, Me. He formerly was vice-president and works manager of WHITIN MACHINE WORKS.

New York and New Jersey

UNION CARBIDE METALS CO., a division of UNION CARBIDE CORPORATION, New York City, has appointed JOHN C. DOUGLAS vice-president–operations and DAVID SWAN vice-president–technology. Mr. Douglas has been with the company since 1934 and vice-president–technology since 1957. Mr. Swan has been with the corporation since 1946 and manager–planning since 1959.

OAKITE PRODUCTS, INC., New York City, has announced the appointment of four new technical representatives to its field service staff. HARLIS E. MARTIN has been assigned to Rock Island, Ill.; CHARLES W. PEARCE to Miami, Fla.; KEITH D. JONES to west Indianapolis, Ind.; and DOUGLAS W. VONDERHAAR to east Cincinnati, Ohio.

EDLUND-MATIC NUMERICAL TAPE CONTROLLED DRILLING & TAPPING MACHINE

The newest Layout Drilling Machine with Numerical Tape or Dial Control. Economically performs multiple operations for Single Piece Layout Work Short Run Production
The entire sequence of operations can be repeated time after time with no chance of operator error—minimizes operator attendance and skill.

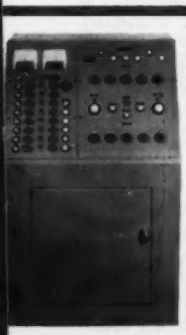
FEATURES

- Flexibility in setting up a wide variety of operations.
- Quick conversion from one drilling job to another.
- Work from standard detailed drawings.
- Standard 1" 8 channel punched tape.
- Tape or Dial control.
- Infinitely variable spindle speeds 225-2700 rpm.
- Infinitely variable feeds 1 to 7 inches per minute.
- Nine different operations or tool changes at one setting.
- Foolproof tool rack (available) prevents use of incorrect tool.

FEATURED at the National Machine Tool Exposition

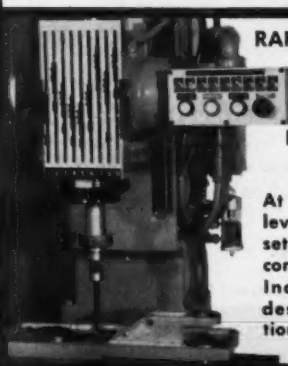
* PATENTS PENDING

Write for Bulletin 200.



CONTROL CONSOLE

Operation Selector Switch and Lights for nine operations
Spindle Speed and Feed Setting Knobs and Tachometers.
Table Positioning Dials for two axiis.
Zero Offset Dials.



RAPID ADVANCE AND FEED STOPS PLUS PENDANT PUSH BUTTON STATION

At convenient eye level for precision setting and easy control.
Indicator Lights designate operations.

EDLUND COMPOUND TABLE

A new concept in extremely rapid positioning table. Many exceptional features. Table Travel 14" x 20". 200"/per min.

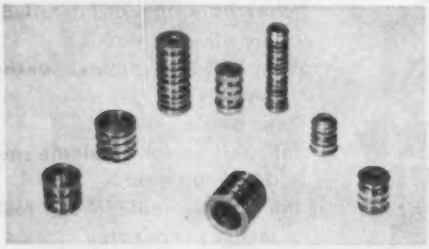
Special Contract Job work can also be arranged with Edlund. Send Part, Blueprint and Requirements.

EDLUND
MACHINERY COMPANY
Cortland, New York Division of Harsco Corporation

EDLUND REPRESENTATIVES IN MAJOR CITIES

WHY MICROHONING* helps Hawk Guidance System "think" straight

The Army-Marine surface-to-air Hawk missile is the first of its kind to overtake and destroy a ballistic missile in a simulated enemy attack. Designed by Raytheon's Missile Systems Division, it is being built at their Andover, Massachusetts plant.



Representative range of valve sleeves Microhoned.

MICROHONING GENERATES ACCURACY

With consistent accuracy as a prime requisite, Raytheon engineers specify Microhoning in the processing of valve sleeves and blocks used in the servomechanism that guides the Hawk in its supersonic flight. Microhoning of bores rectifies geometric inaccuracies, size is held within .0003", roundness within .0001" tolerance, and a surface finish of about 8 microinches (rms) is generated.

MICROHONING'S VERSATILITY

Thirteen different sizes of sleeves and blocks are Microhoned, including those with blind-end, interrupted, and ported bores. Parts, which are generally of stainless steel heat treated to 58-60 R "C", have bore diameters ranging from .171" to .874" and lengths from .594" to 2.859".

STRAIGHT, CLEAN BORES

Microhoning of these components effectively corrects camber or bow in the bore and assures less smear around the ports than possible with any other machining method. Bore camber and smear could cause binding or a hindering action between the sleeve and its spool, and thus throw the missile off-course.

The strong emphasis on precision can best be appreciated in the realization that sleeves and mating spools must operate within a clearance of only 100 to 150 millionths of an inch. The fit of the spool within the sleeve must prevent blow-by. A final lapping operation provides geometric accuracy within .000050" tolerance.

For further details, see facing page.

**Registered U. S. Pat. Off.*

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

I. JOHN BILLERA has been elected executive vice-president—operations of U. S. INDUSTRIES, INC., New York City, in a new alignment of executive responsibilities. Mr. Billera was previously senior vice-president of the company. In the new structure,

I. John Billera, executive vice-president in charge of operations, U. S. Industries, Inc.

he will be directly responsible to the chairman of the board and president for the operations of USI's thirteen divisions and subsidiaries. In turn, the vice-presidents in charge of operating groups of the company's divisions and subsidiaries will report to Mr. Billera.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, has granted a distributorship on Hannifin air control valves and power cylinders for hydraulic and pneumatic applications to NIELSEN HYDRAULIC EQUIPMENT INC., 6 Penn Place, Pelham Manor, N. Y., with branch operations in Linden, N. J., and West Hartford, Conn.

M. & E. LEASING CORPORATION, a new entry in the field of industrial leasing, has been formed as an affiliate of C.I.T. CORPORATION, New York City. Both companies are subsidiaries of C.I.T. FINANCIAL CORPORATION, headquartered in New York.

WARD K. JONES, JR., has been appointed export manager of sales for RUSSELL, BURDSALL & WARD BOLT AND NUT CO., Port Chester, N. Y. Mr. Jones succeeds WILLIAM P. RAVE, who retired March 31 after twenty-six years with R B & W.

NEAL & BRINKER CO., New York City, has been appointed a distrib-

utor by MORSE TWIST DRILL & MACHINE CO., New Bedford, Mass., with sales rights to handle the complete line of Morse products in the New York metropolitan district.

R. JOHN HESS has been appointed manager of metalworking equipment for the FARREL-BIRMINGHAM CO., INC., Watson-Stillman Press Division, Rochester, N. Y. He will be located at the division headquarters.

NEW JERSEY ZINC CO., New York City, has announced the election of JAMES R. ALEXANDER as vice-president. He will be in charge of the sale of the company's products, succeeding ROBERT G. KENLY, who will assume new administrative duties. Mr. Alexander was formerly vice-president–sales of H. K. PORTER CO., INC., Thermoid Division, Trenton, N. J.

James R. Alexander, vice-president in charge of sales, New Jersey Zinc Co.

The appointment of ADOLPH R. SCHAUB as vice-president of manufacturing has been announced by L. J. WING MFG. CO., division of Aero Supply Mfg. Co., Inc., Linden, N. J. Mr. Schaub has been manager of manufacturing since joining Wing in January.

Ohio

The promotion of WILLARD E. ANDERSON to the newly created position of regional manager for the eastern central area of the country is announced by PARKER-HANNIFIN CORPORATION, Cleveland, Ohio. Mr. Anderson, with headquarters in the Parker-Hannifin sales office at 17325

HOW MICROHONING corrects camber in components of Hawk Missile

Raytheon, designer and builder of Hawk missiles, is constantly seeking to improve processing methods and attain greater precision-production. One example of this is the processing of valve sleeves and blocks used in the steering mechanism of Hawk missiles. Here's how Microhoning corrects bore camber, minimizes smear around ports, generates geometric accuracies and microinch surface finishes.

CORRECTING BORE CAMBER

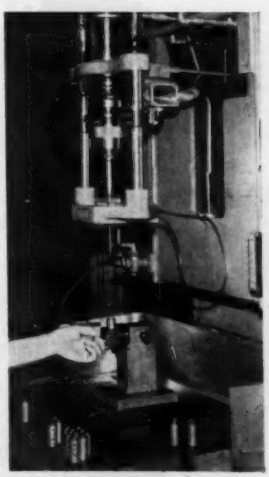
To straighten bore surfaces so that they are parallel throughout their length to the neutral axis of the bore, Microhoning utilizes the combination of: abrasive sticks of exact length, positive radial expansion of abrasives, and controlled rotating and reciprocating motions of the Microhoning tool.

Each Hydrohoner has automatic *size control, stonefeed and stonewear compensation.*

MINIMUM SMEAR AT PORTS

Thirteen different sizes of sleeves and blocks are Microhoned, including those with blind-end, interrupted, and ported bores.

The Microhoning characteristics of low-velocity abrading and constant widespread contact with bore surfaces eliminate more smear around the ports than is possible with any other machining method.



Simple fixturing and hand loading are part of this careful processing.

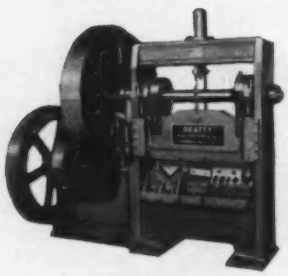
EFFICIENT PRECISION PROCESSING

In two Microhoning operations, from .002" to .006" stock is removed from the bores at an approximate rate of .001" per minute. The rough Microhoning removes from .001" to .005" stock while correcting camber to within .0003". The finish Microhoning rectifies geometric inaccuracies resulting primarily from heat treating of parts. Size is held within .0003", roundness within .0001" tolerance, and surface finish generated is about 8 microinches, rms.

For further details, see facing page.

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

MAJOR SAVINGS
are yours
with the installation of
BEATTY GUILLOTINE BAR SHEARS!



BEATTY GUILLOTINE BAR SHEARS!

enable you to shear rounds . . . squares . . . angles . . . and bars . . . without changing tools . . . offering you important savings in shearing costs through the elimination of tool changing time on short-order runs of different steel shapes.

Suitable for either production or "short order" shearing, the Beatty Guillotine Bar Shears are available in capacities for handling 43 tons up to 300 tons. A range of nine models permits you to select the models best suited to the special metalworking needs of your plant.

When the objective is to cut metalworking production costs, it pays to investigate the Beatty family of metalworking equipment.

WRITE for FREE DESCRIPTIVE LITERATURE on the Beatty line of shears, punches, presses, bulldozers, spacing tables, and stamping trimmers.

BEATTY
MACHINE & MFG. COMPANY
941 150th St., Hammond, Indiana

Euclid Ave., Cleveland 12, Ohio, will supervise the direct sales engineers and the district managers of distributor sales in the Ohio, Indiana, Kentucky, West Virginia, and western Pennsylvania regions.

RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, Ohio, has announced the following assignments: WOODROW L. HANSON has been named general superintendent of the company's Ivanhoe division; C. PORTER PACKARD is manager of marketing services for the company; J. D. ZELAZNY and ROBERT DEKLOTZ are sales engineers in Youngstown, Ohio, and Los Angeles, Calif., respectively; and CLYDE W. SEAL has been made Reeves product manager in the company's marketing division.

LINCOLN ELECTRIC CO., Cleveland, Ohio, announces the transfer of DAVID J. FULLEN from Philadelphia to their York, Pa., suboffice. Mr. Fullen replaces GORDON T. COLLIER, who was transferred to Cincinnati, Ohio. THOMAS BAUER, a recent appointment to Lincoln's staff of field welding engineers, has been assigned to the Philadelphia office.

The appointment of LOUIS H. HEIN CO. as a distributor for the industrial air and hydraulic cylinders and air control valves made by Hannifin Co. division in Des Plaines, Ill., was announced by PARKER-HANNIFIN CORPORATION, Cleveland, Ohio. The Louis H. Hein Co. has warehouse operations in West Conshohocken, Pa.; Jersey City, N. J.; and Baltimore, Md.

Pennsylvania and Maryland

BALDWIN-LIMA-HAMILTON CORPORATION, Philadelphia, Pa., has speeded manufacture of its Hamilton cam-making machinery by integrating machining and assembly operations into one self-contained shop now in operation at its INDUSTRIAL EQUIPMENT DIVISION, Eddystone, Pa. The division, a manufacturing, engineering, and sales organization is replacing three former BLH divisions: Hamilton, Loewy-Hydropress, and Eddystone.

CRUCIBLE STEEL COMPANY OF AMERICA, Pittsburgh, Pa., has named ROBERT D. LESLIE manager of the company's sales branch in Charlotte, N. C. CHARLES S. LUTZ, office manager, will remain in his position and will have full responsibility for the direction of the internal functions of the branch, including customer contact through desk sales.

TOTALLY NEW AIR TOOL

Hogs, Blends, Finishes Metal Faster!

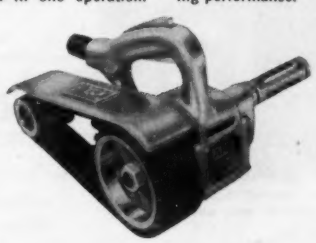
ARO Portable Belt Grinder

You're looking at a new ARO Belt Grinder in action. In this all-new production tool, Aro has combined the backstand idler principle of abrasive grinding with *portability* and *power* to remove metal faster. Live action of the coated abrasive belt running at high speed over slotted, resilient rubber contact wheel sets the abrasive grains "on edge" to give more bite. The metal is actually *sheared* off! Action is smooth and true—no chattering, bumping or bouncing. And you can rough grind and finish in one operation, because the abrasive belt method doesn't leave gouges or swirls in the work. Free belt stropping of corners and radii is easy, too. Beat high grinding costs with new Aro Belt Grinders. Job test one. Ask your Aro Distributor.

Cuts Metal like Butter!

1 Take a rough 6" weld like this. Put a powerful Aro Belt Grinder on the job, and take the grind out of grinding! Full 2 H.P. air motor running at 6000 R.P.M. produces 7000 S.F.P.M. Belt speed—you hog and finish in one operation.

2 Here's the result just 1¾ minutes later, using a 24-grit belt. This is typical of the outstanding performance you can expect from the new portable Aro Belt Grinder—only tool of its kind—unbeatable for grinding performance.



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AIR TOOLS

AIR HOISTS • AUTOMATION TOOLS
ULTRASONIC CONTROLS

THE ARO EQUIPMENT CORPORATION
Bryan, Ohio

Aro of California, 3141 S. Grand Avenue, Los Angeles 7, California; Aro Equipment of Canada Ltd., Rexdale (Toronto), Ontario
Offices in all Principal Cities

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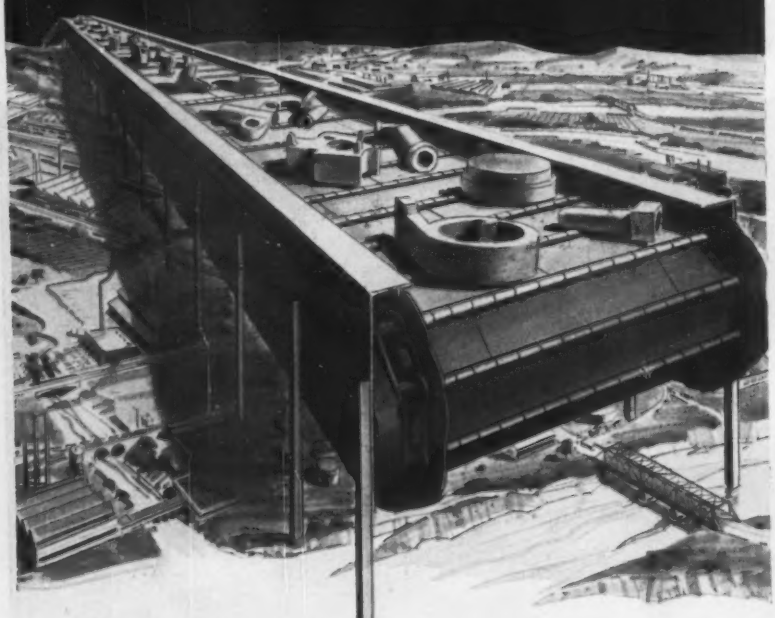
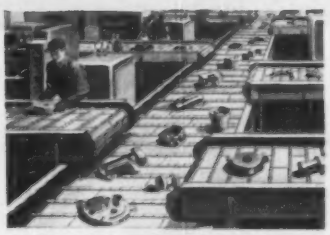
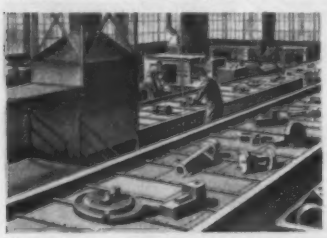
For the metalworking industry...



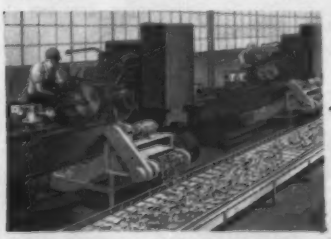
MAY-FRAN hinged-steel conveyor belting!



Main and feeder conveyors provide low-cost product flow throughout the plant.



Heavy-duty steel belting defies destruction regardless of products or materials handled.



Automatic scrap removal assures continuous operation of machine tools and lower production costs.

Now! . . . You can build customized conveyors from low-cost standard components. Sections are assembled to your specifications to handle all types of hot, heavy or abrasive materials. Installations can be made at any elevation above or below the floor level. Cleats and pockets will prevent fallback on inclines. Perforated belt links provide efficient cooling for hot forgings or drainage for cutting oils and coolants. When your material handling costs are out of line, let MAY-FRAN suggest the answer.

Call or write today for your copy of MF 100.

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CLEVELAND 12, OHIO
a division of FISCHER & ASSOCIATES, Inc.
9082-MF

The appointment of JOHN E. ANGLE as administrative vice-president–Steel Producing Divisions has been announced by United States Steel Corporation, Pittsburgh, Pa. Mr. Angle, who formerly was vice-president–industrial engineering, succeeds OSCAR PEARSON, who has been appointed executive vice-president of United States Steel's Tennessee Coal and Iron Division.

CARPENTER STEEL CO., Reading, Pa., has announced the appointment of JOHN W. KEEGAN as metallurgist–hot and cold heading steels. ANDREW R. WALSH has been promoted to assistant metallurgist–high-temperature alloys, and CHARLES A. DIVINE, JR., was made assistant metallurgist–stainless steels.

CHICAGO PNEUMATIC TOOL CO., New York City, has announced the appointment of JOHN KACMARIK to the position of general manager of the company's plant at Franklin, Pa. Mr. Kacmarik will succeed H. E. MOORE, who is retiring after forty-one years with the company.

ALBERT E. EDWARDS has been appointed to the newly created position of assistant vice-president–manufacturing for TEXTILE MACHINE WORKS, Reading, Pa.

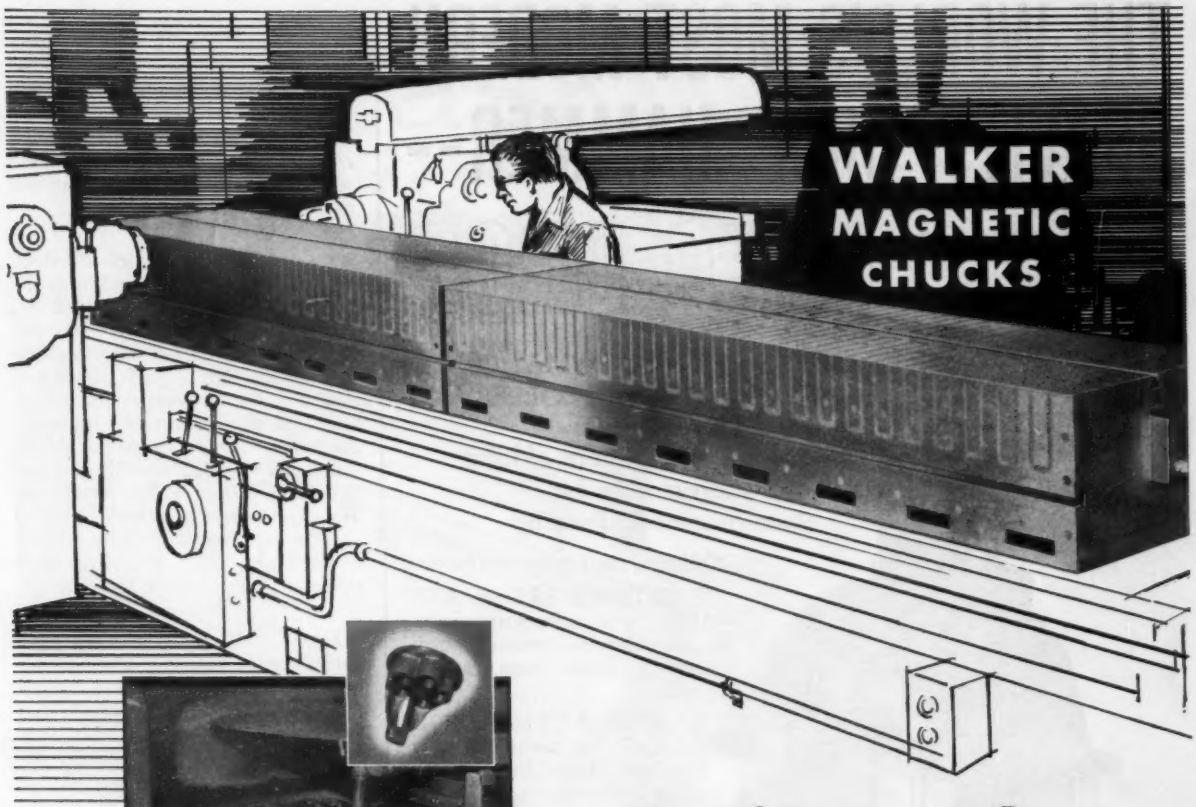
W. KENT KISE, JR., has been appointed by CARPENTER STEEL CO., Reading, Pa., as assistant manager–electronic alloy sales, with headquarters in the Reading office.

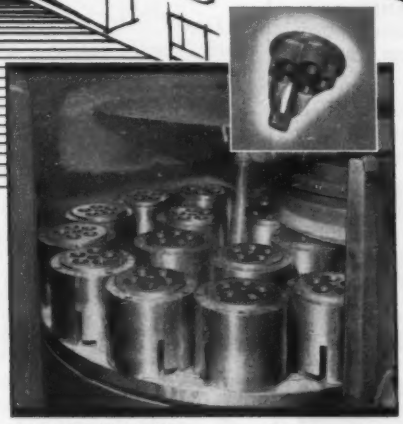
PANGBORN CORPORATION, Hagerstown, Md., announces the appointment of three process engineers, all specialists in vibratory finishing. WILLIAM E. BRANDT, JR., is assigned to the Hagerstown office; BARRY L. SELACK to Cleveland, Ohio; and JOHN G. WEBER to Milwaukee, Wis. Their purpose is to assist and advise all companies on applications or problems in vibratory or precision barrel finishing.

BLACK & DECKER MFG. CO., Towson, Md., has made CHARLES SPOERER plant manager of the company's Hampstead, Md., plant. Also announced were the appointments of GEORGE H. DANSBERGER as toolroom foreman at Hampstead and DAVID W. JONES, JR., as supervisor of scheduling and dispatching.

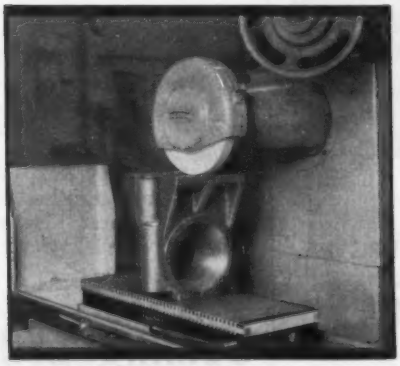
Texas

CLECO DIVISION of the Reed Roller Bit Co., Houston, Tex., an-





SPECIAL ROTARY
A special rotary auxiliary plate with cylindrical magnetic raising blocks holds irregularly shaped parts of grinding with quick easy set ups.



CERAMAX PERMANENT
A rugged Walker "Ceramax" chuck with ultra permanent ceramic magnets holds a large part for precision grinding.

Engineered MAGNETIC Applications

Walker engineers are continuously solving *new* holding problems for industry. The three-faced electromagnetic chuck above is only one example of the special designs created by Walker ingenuity and "knowhow". Whether you need any one of the complete line of standard magnetic chucks or a specially designed item, your best source is Walker.

O.S. Walker Co., Inc.

ROCKDALE ST. • WORCESTER 6, MASS.

Original Designers and Builders of Magnetic Chucks

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THE WORLD'S MOST MODERN GRAVITY DROP HAMMER--

The IMPROVED **CECO-DROP**

with CECO BLOWMATIC PROGRAM CONTROLLER
(illustrated below)
Pre-selected pattern of long and short strokes for Semi-automatic Forging

Other great new features:

DIE SETTING EASIER AND SAFER: by means of new ram-inching device, operator can raise or lower ram, safely at will.

FASTER ACTING ROD CLAMP: by means of new Double-acting Clamp Operating Cylinder.

WEAR-REDUCING NYLON-TIPPED KNOCK-OFF DOG: reduces shock to valve control rigging; reduces wear on ram incline.

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DESIGNERS AND MANUFACTURERS OF THE IMPACTER

When it's a vital part, design it to be FORGED

nounces that ROBERT B. NORRIS has been named a field sales engineer for the Philadelphia, Pa., area. The firm's offices are located in that city at 5220 N. Fifth St. PAUL MCKIM MITCHELL has been named Boston representative for Cleco. He will service that city and the surrounding trade area.

CARPENTER STEEL CO., Reading, Pa., has opened a new office in the Lee Park Building, 3511 Hall St., Dallas, Tex. It will serve the increased need for specialty steels in the Dallas–Fort Worth marketing area and will provide faster service for more than twenty-five cities in the territory, as well as in the nearby states of Colorado, New Mexico, and Wyoming. JOHN D. WILSON and HAROLD G. SIMS have been assigned as sales representatives to work out of the Dallas office. The order desk salesman is ALAN D. WHATLEY.

DONALD R. HARTER has been made district manager of the Houston, Tex., office of VICKERS INCORPORATED, division of Sperry Rand Corporation, Detroit, Mich. He will be in charge of sales and service for Vickers industrial and mobile hydraulics.

CLECO DIVISION of the Reed Roller Bit Co., Houston, Tex., has appointed RAY KENSEL to the newly created position of export sales manager, with headquarters in Houston. Prior to his appointment, Mr. Kensel had been Detroit division manager since 1953. In his new capacity he will handle foreign sales, government work, and original equipment sales.

France

LANDIS TOOL CO., Waynesboro, Pa., announced the purchase of GENDRON FRERES, S. A., the largest precision grinding machine company in France. Gendron Freres is the second European acquisition by Landis Tool Co. in the past two years. In 1958 the company acquired LANDIS LUND LIMITED, located at Cross Hills, near Keighley, in the northern part of England.

Coming Events

OCTOBER 17-21—Forty-Second National Metal Exposition and Congress, sponsored by the American Society for Metals, to be held at Philadelphia Trade and Convention

For a pre-cleaning short-cut to better plating

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS

Now—remove smut, rust and soils with one electrocleaner: Oakite 190

Here is a new reverse-current cleaner that performs two operations at once. (1) It removes the oily soils normally requiring an alkaline cleaner . . . and (2) it removes smut and rust bloom normally requiring additional treatment.

New Oakite 190 performs this double duty because it's a *chelated* detergent. Chelation—which makes metallic salts and oxides soluble in water—handles the removal of smut, heat scale and rust. Powerful alkaline detergency handles the removal of oil films and shop soil. As a bonus, Oakite 190 has high conductivity, rinses well in hot or cold water.

Result: new Oakite 190 insures fewer plating rejects due to inadequate pre-cleaning, *eliminates an entire operating step* in many instances.

For more details about Oakite 190, ask your local Oakite man or write to Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

over 50 Est. 1909 SCIENCE

years' leadership in industrial cleaning

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Center, Philadelphia, Pa. For additional information: Chester L. Wells, exposition manager, American Society for Metals, Metals Park, Novelty, Ohio.

OCTOBER 25-27—Eleventh National Conference on Standards under the auspices of the American Standards Association. The Conference is to be held at the Sheraton-Atlantic Hotel, New York City. For additional information, inquire of K. G. Ellsworth, Public Relations, American Standards Association, 10 E. 40th St., New York 16, N. Y.

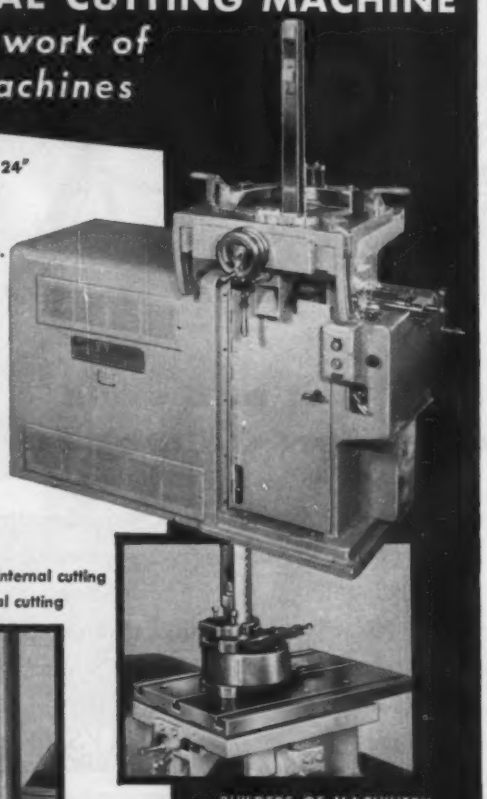
NOVEMBER 3 and 4—Annual Regional Conference and Convention of the American Institute of Industrial Engineers to be held at the Sheraton Plaza Hotel, Boston, Mass. For further information: Marshall Schneider, chairman, publicity committee, American Institute of Industrial Engineers, Inc., Boston, Mass.

NOVEMBER 14-18—Third Western Tool Show sponsored by the American Society of Tool Engineers, to be held at the Memorial Sports Arena in Los Angeles, Calif. For additional information write Leonard Abrams, exposition manager, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.

AMAZING NEW HYDRAULIC M&M KEYSEATER AND VERTICAL CUTTING MACHINE

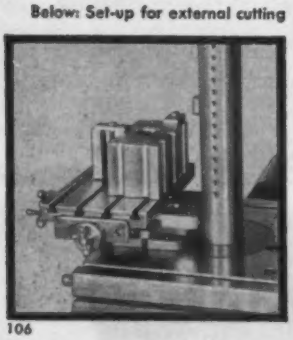
does the work of many machines

In addition to a keyseater that cuts internal keyways up to 3" wide x 24" long, the new hydraulic M & M is a handy tool room machine and can be easily adapted to special production jobs other than keyways. A wide variety of internal or external cuts, serrations, grooves and teeth can be rapidly made on this machine. With a combination tilting table and index table (shown on machine at right) straight or tapered bores and accurately spaced multiple keyways or splines may be cut at any degree of the circle. Send us prints of your cutting problems.



Right: Set-up for internal cutting

Below: Set-up for external cutting



BUILDERS OF MACHINERY SINCE 1854

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M&M KEYSEATERS AND VERTICAL CUTTING MACHINES

MITTS & MERRILL • 64 Holden St. • SAGINAW, MICHIGAN

New Books

CHIPLESS MACHINING. (Subtitle: Methods of cold forming ferrous metals including heading, rolling, spinning, swaging, extruding, and high-energy-rate forming.) By Charles H. Wick. 502 pages; 6 by 9 inches; 326 line and halftone illustrations. Published by THE INDUSTRIAL PRESS, 93 Worth St., New York 13, N. Y. Price, $10.

This book features the description of various production processes for the cold-working of steel, the essential steps in making parts by these methods, the design of equipment and tooling necessary for the use of the processes, typical applications, and the economies of *moving* metal rather than *removing* it. Working data is included on the new processes of spline and gear rolling, radial forging, power spinning, cold extrusion, and explosive and other high-energy-rate forming.

The book brings together pertinent information on such processes in the form of a convenient and valuable guide which would be helpful in planning and tooling for chipless machining. Use of the book should result in wider and more rapid application of these processes as a result of the authentic and detailed information given. In addition to explaining the various processes (including the most recent advances), their advantages and limitations, and typical applications, the book serves as a guide to the design or selection of machines, tools, and accessories.

Although this book has not been written for classroom instruction, it will serve as a very useful reference in any metal processing or production planning course.

Topics covered, by chapters, are: chipless machining—what it is and what it is not; metallurgical considerations of plastic deformation; cold-heading; thread-rolling; rolling of serrations, splines, and gears; power spinning; rotary swaging; internal swaging, radial forging, and cold-forming of multiple-diameter shafts; cold extrusion of steel; selecting materials and designing parts for cold extrusion; production of slugs and secondary operations; phosphate coating and lubricating for cold extrusion; die design for cold extrusion; and explosive forming

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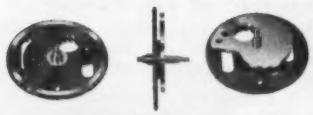

Two Dimensional Cam and Gear made from one piece of bar stock

Three Dimensional Cam—over 12,000 calculations

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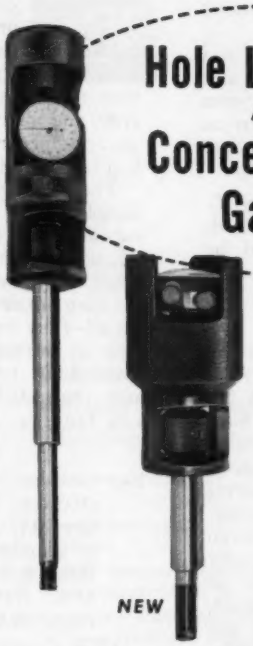
Hole Locating AND Concentricity Gages



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- ★ *direct reading*
- ★ *precision made*
- ★ *hardened and lapped*
- ★ *special models engineered*
- ★ *seven standard models*

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Location and Concentricity Fixtures
Special Machines
Tools and Gages
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MAYES TOOL CO.
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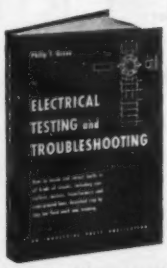
TESTED ELECTRICAL PROCEDURES DESCRIBED BY AN EXPERT



ELECTRICAL TESTING AND TROUBLESHOOTING, by Philip T. Green explains tested procedures clearly and completely.

This book will show you how to locate and correct faults in circuits of all kinds, including—controllers, motors, transformers and transmission lines. A briefing on electrical symbols and diagrams is followed by detailed discussions on: Analyzing and charting controller operation, Insulation testing, Electromagnet winding, Single-Phase transformers, Polyphase transformers, Synchronous motors, Troubleshooting test equipment, Locating grounds, D.C. machine windings, Phase sequence, Induction motors, Power cable faults, Bearing lubrication.

The tests are performed with the equipment isolated from the power line. Current is supplied by dry cells or residual magnetism so that accidental contact and short circuits are less hazardous. All of the trouble shooting procedures described here have been tested and proven to be great time-savers—especially for locating obscure source of trouble.

200 Pages, 100 Illustrations, Flexible Fabrikoid Binding, $5.00.

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NEW La Salle EXPANDING ARBORS*

accurately position any type of part or tool for machining, grinding and inspection operations

Grinding Arbor

Expanding Sleeve (In-Line Grooves)

Expanding Sleeve (Staggered Grooves)

ADVANTAGES

Vise Like Grip
Better Balance
Squareness of Faces
Better Finish
Improved Design
Closer Concentricities
No Wobble
Any Size

- Ends expand independently
- Expansion can be different at each end
- No loose or movable parts—centrifugal force will not throw arbor out of balance

WRITE FOR CATALOG SHEET NO. 120 *Patent Pending

La Salle *machine tool, inc.*
SPECIAL MACHINE TOOLS
21535 Hoover Road • Warren, Michigan

For more data circle 283C

and other high-energy-rate forming methods.

The author, Charles H. Wick, is a graduate mechanical engineer and was associate editor for eight years and managing editor for six years on the staff of MACHINERY magazine.

WORK IMPROVEMENT. By Guy C. Close, Jr. 388 pages; illustrated; 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $7.75.

The basis for suggesting any improvement in work rests in a prior understanding of the nature of the people engaged in that activity. Such an understanding, combined with the scientific approach to problems and a brief history on the pioneers of the Scientific Management movement, form the background material in this book. All of it is naturally directed to the main purpose of making an enterprise pay; therefore, the competitive picture and the profit motive in business are heavily stressed.

Methods and techniques used by business, industry, and service organizations to reduce costs and increase productivity are incorporated in this book. In clear, direct fashion the author explains the use of a systematic, organized method for solving cost problems in a practical manner. Suggestions are given on how to eliminate wasted time, energy, and materials, and which tools are appropriate for the type of problem being studied.

The analytical application of work sampling and principles of motion economy, the comparative utility of job simplification versus job enlargement, and the use of imaginative thinking are described and explained for all—from foremen to executives—who are interested in work improvement. Each technique is supported and illustrated by examples and case histories.

ELEMENTARY ENGINEERING MECHANICS. By Eugene George Key. 457 pages; illustrated; 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $5.50.

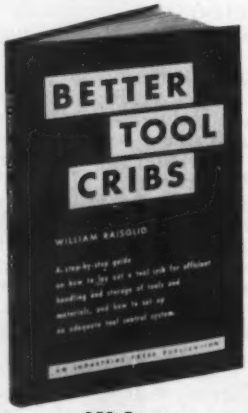
All the essential elements of statics and dynamics and their application to engineering problems are fully described. This textbook is divided into two parts: Part I deals with the subject of statics, or stationary bodies; Part 2 covers the subject of dynamics, or moving bodies. Both subjects, as treated here, can easily be covered in a one-semester course in elementary mechanics.

Students and other users of this book require a knowledge of mathematics up to, and including, plane geometry and second-year high school algebra, plus the ability to learn and to use trigonometry. Knowledge of trigonometry before using this book should not be necessary, since there is sufficient explanation in the text to satisfy the requirements. Because of this, the book can be employed as a text in technical courses by students who expect to go into technical work after a two-year course, rather than a four-year course, that leads to an engineering degree.

A simplified approach is used to explain nonconcurrent, noncoplanar, nonparallel force systems. Engineering principles are pinpointed and analyzed to simplify any task of analyzing either a theoretical or actual force system. The book describes variable forces and variable acceleration that is completely divorced from calculus for the first time. It simplifies the analysis of truss problems without sacrificing principles.

For more data circle Item 284A

TAKE A LOOK AT YOUR TOOL CRIB



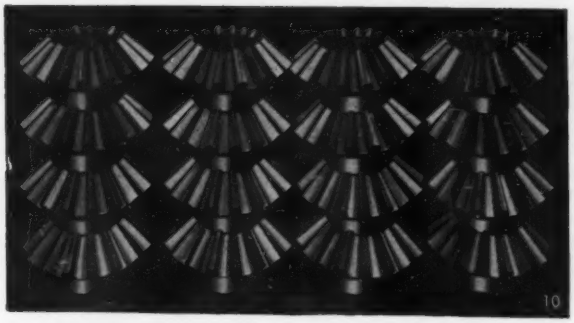
152 Pages
87 Illustrations
$4.00

Does it help – or hinder production?

BETTER TOOL CRIBS gives you detailed descriptions of how such items as milling cutters, honing units, counterbores, fly cutters, measuring tools, gages, machine parts and other shop equipment and materials should be stored. Several complete control systems based on the use of brass tool checks and triplicate tool charge slips are clearly described. A whole chapter is devoted to the step-by-step layout of a complete tool crib, and shows how the maximum benefits can be derived from the proper location of the various pieces of storage equipment and materials stored therein.

The Industrial Press

93 Worth St. New York 13, N.Y.



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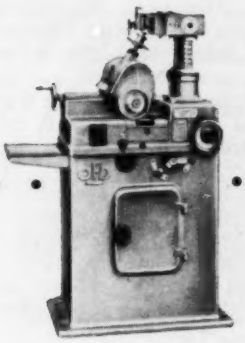

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METALWORKING'S MECHANICAL PRESS HANDBOOK. 256 pages; illustrated; cloth; 6 by 9 inches; indexed. Published by *Metalworking* Magazine, 221 Columbus Ave., Boston 16, Mass. Price, $5.

This handbook approaches the subject of mechanical presses in a comprehensive manner, yet its style is easy and conversational. It can boast an excellent editorial board composed of top engineers and executives from seven of the largest press manufacturing companies.

Large presses and high-production presses for production line applications dominate the descriptions. Some of the chapter headings: Press Drives, Clutches and Brakes, Flywheels and Motors, Die Cushions and Counterbalances, Overload Devices, and Lubrication Systems. Other chapters are devoted to frame design and construction while others discuss the major groupings of production stamping and shearing presses with feeding and unloading devices. Transfer presses and welding presses are given chapter treatment.

Several classes of high-production mechanical presses not used primarily in automotive and appliance sheet metal forming are omitted, perhaps because there have been relatively few recent changes in design and construction. The general grouping of mechanical presses includes eyelet presses, four-slide machines, and powder metal presses. Each one possesses its own factors of design and application.

The chapters on design and construction of press components are written in a thorough, logical sequence and should make the book an invaluable text for engineering students and company training groups.

MECHANICS OF MATERIALS. By Archie Higdon, Edward H. Ohlsen, and William B. Stiles. 502 pages; illustrated; 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $7.75.

Although essentially traditional in its organization, this book features an approach compatible with the engineering science viewpoint. It is designed to help the reader develop (1) a working knowledge of the relations between the loads applied to a nonrigid body of a given material and the resulting deformation of that body, (2) a thorough understanding of the relations between the loads applied to a nonrigid body and the stresses produced in that body, (3) a clean insight into the relations between stress and strain for a wide variety of conditions and materials, and (4) adequate procedures for finding the required dimensions of a member of specified material to carry a given load subject to stated specifications of load and deflection.

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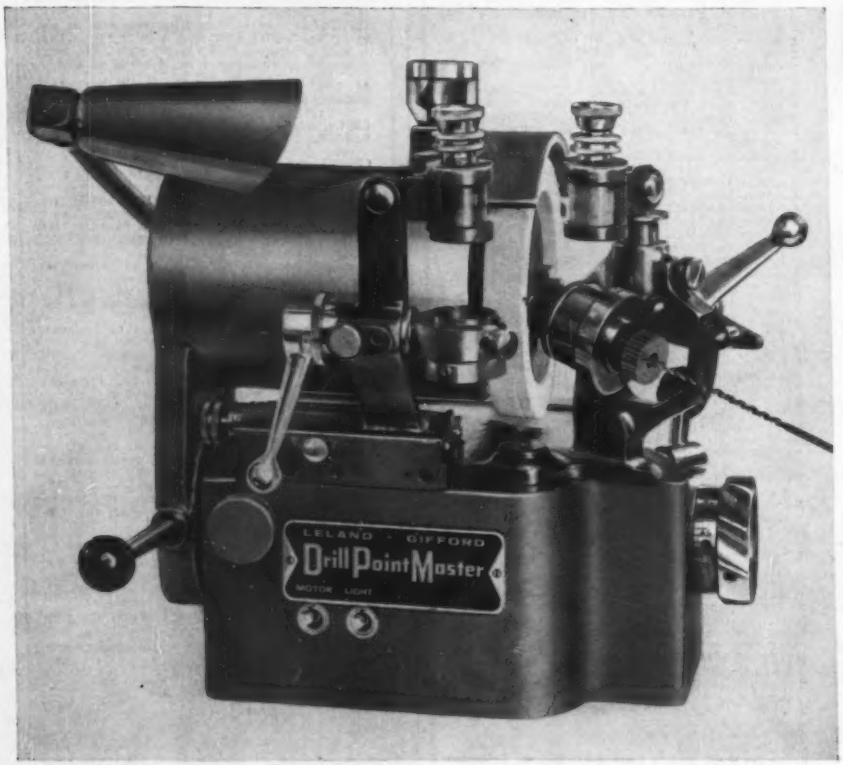

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HARTFORD DETROIT CHICAGO

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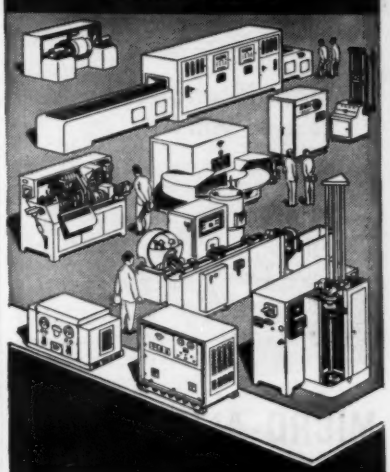

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MOTOR GENERATOR

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Optical tooling publications: "Penta Prism Behavior" and "Precision Polygons" — a full treatment of the most important optical tooling accessories.

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EQUIPMENT COMPANY
DIVISION OF ENGINEERING AND SCIENTIFIC INSTRUMENTATION
431 SOUTH DEARBORN ST.
CHICAGO 5, ILL.

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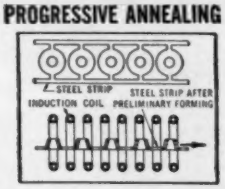
Lepel induction heating equipment represents the most advanced thought in the field of electronics...the most practical and efficient source of heat developed for numerous industrial applications. You are invited to send samples of work with specifications. Our engineers will process and return the completed job with full data and recommendations without cost or obligations.

TYPICAL INDUCTION HEATING APPLICATIONS

PLASTIC COATING OF TOOL HANDLES

A production line operation for coating handles of tools at Whitney Metal Tool Co., Rockford, Ill. uses induction heating with excellent results. The handles only are heated by induction to the desired temperature then dipped into a vinyl chloride base coating material for a short period depending upon the thickness of coating desired. The plastic coating formed on the handles is then cured by immersion in a carbo-wax bath.

FORMING OF METAL STRIP FACILITATED BY PROGRESSIVE ANNEALING



Metal forming operations which require intermediate anneals to restore ductility can be facilitated by induction annealing the strip progressively. Diagram illustrates this procedure for partially formed thin austenitic stainless steel strip. The induction annealing operation is scheduled in the production line between two press operations. Metal strip and wire of other materials are also induction annealed in this manner.

WRITE FOR NEW LEPEL CATALOG
Electronic Tube Generators from 1 Kw to 100 Kw.
Spark Gap Converters from 2 Kw to 30 Kw.

LepeL HIGH FREQUENCY LABORATORIES, INC.
55th ST. & 37th AVE., WOODSIDE 77, N. Y.

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Typical Rotoblast Barrel, Ft. Pitt Steel Castings Co., McKeesport, Pa.

proves itself again...and again...and again!

CARRIER CORPORATION, SYRACUSE, N.Y.—Pangborn Rotoblast cleans so quickly it has cut cleaning department labor costs 30% to 40% . . . saving $15,000 a year.

MEADVILLE MALLEABLE IRON CO., MEADVILLE, PA.—Pangborn Rotoblast cut 24 man-hours daily to 15 . . . cleans loads three times as large in half the time.

INGERSOLL RAND CO., PAINTED POST, N.Y.—Pangborn Rotoblast cleans 74,000 lbs. of castings per day, cuts cleaning time in half and substantially reduces costs.

BUCKEYE IRON & BRASS CO., DAYTON, OHIO—Pangborn Rotoblast is automated to reduce labor requirements even further, cuts 15 minutes blast time to just 4½.

Results like these explain why two of the world's leading automotive manufacturers have just ordered *nine* 32 cu. ft. capacity Rotoblast Barrels! If your problem involves blast cleaning, talk to your Pangborn man or write PANGBORN CORPORATION, 1200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Blast Cleaning, Vibratory, Dust Control Equipment—Rotoblast® Steel Shot and Grit.®*

Pangborn
OF HAGERSTOWN

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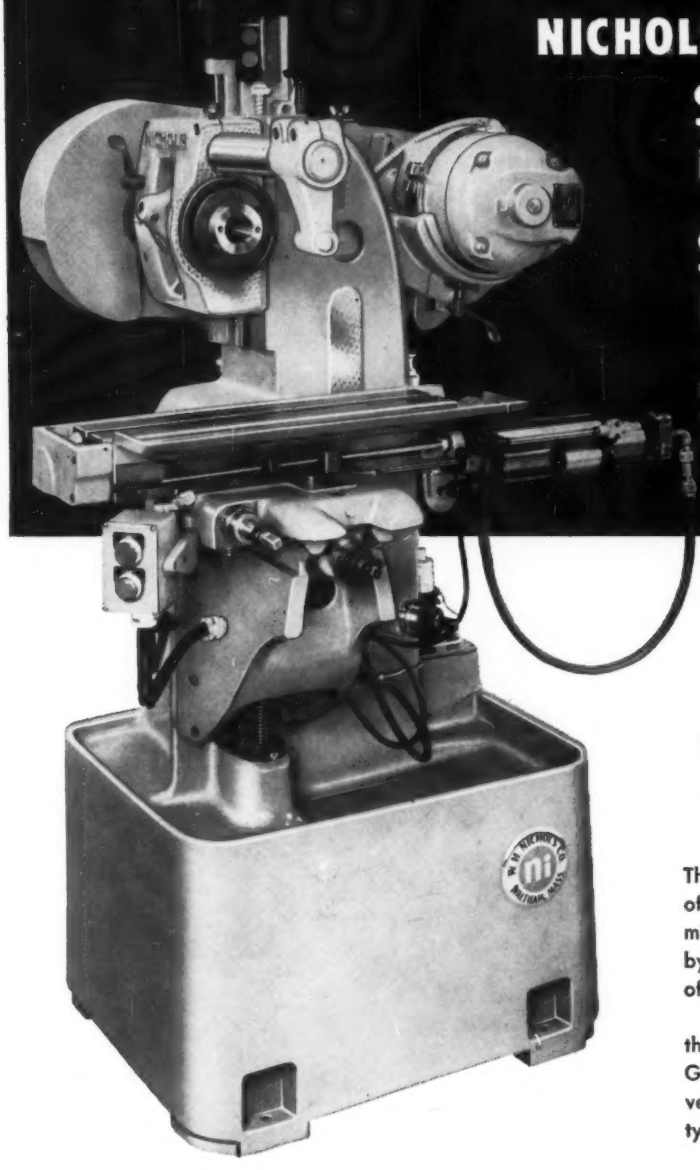

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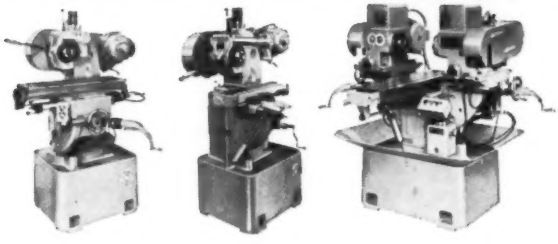

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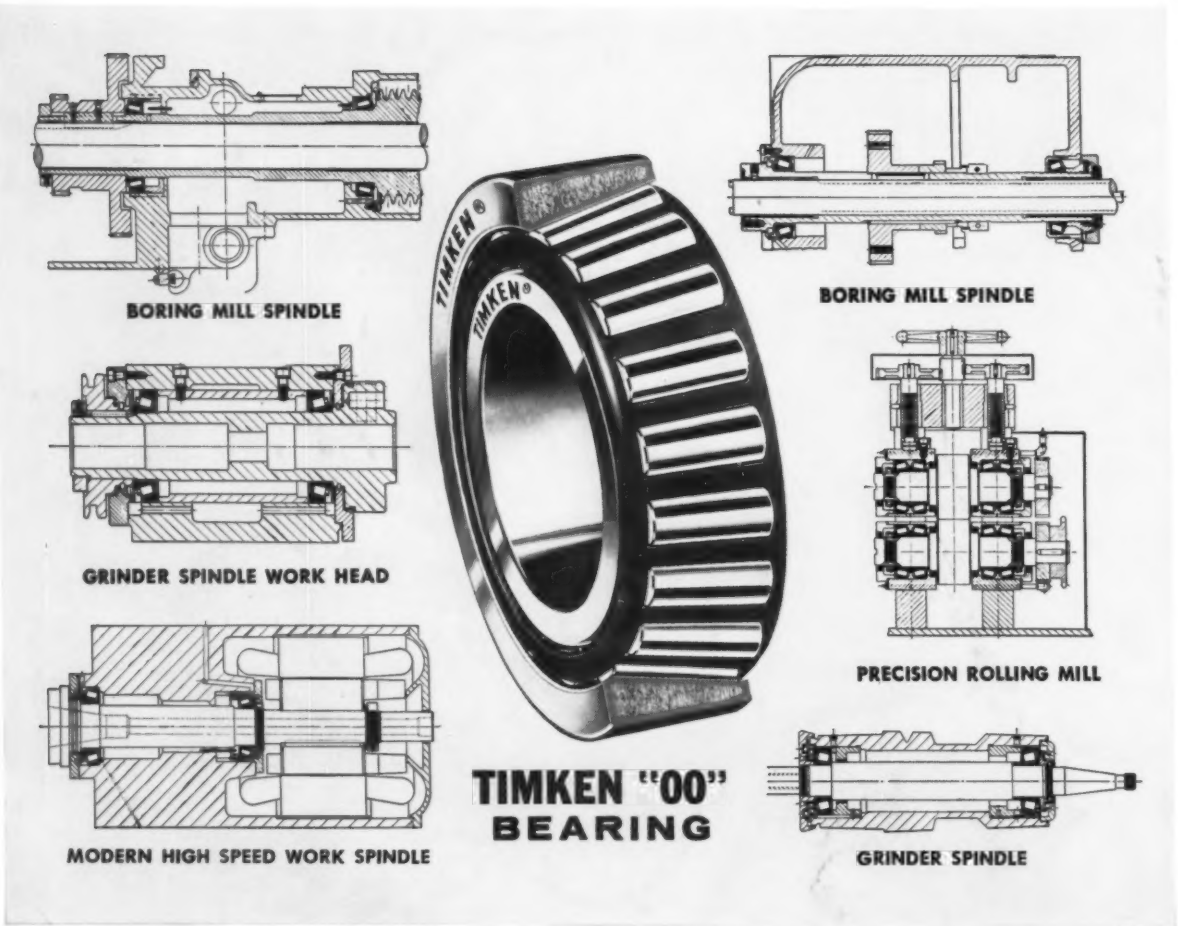

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